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(54) Abstract Title
Dynamic tracking of traded commodity price movement

(57) A system for the dynamic tracking of price movement of a traded commodity, comprises a database for storing details of transactions in the commodity, and a computer programmed to carry out various operations on the stored data.

First, a volume benchmark is calculated from the data in the database, indicative of the average volume of the commodity which has been traded during a preceding time period. Transaction volumes in the commodity are then summed dynamically to produce a running accumulated transaction total. The running accumulated transaction total is compared with the volume benchmark, and the time period is determined during which a volume of transactions corresponding to the volume benchmark occurs. A graphical visual indication of this time period is then generated, to provide a representation of the level of transactions in the said commodity.

GB 2 352 844 A

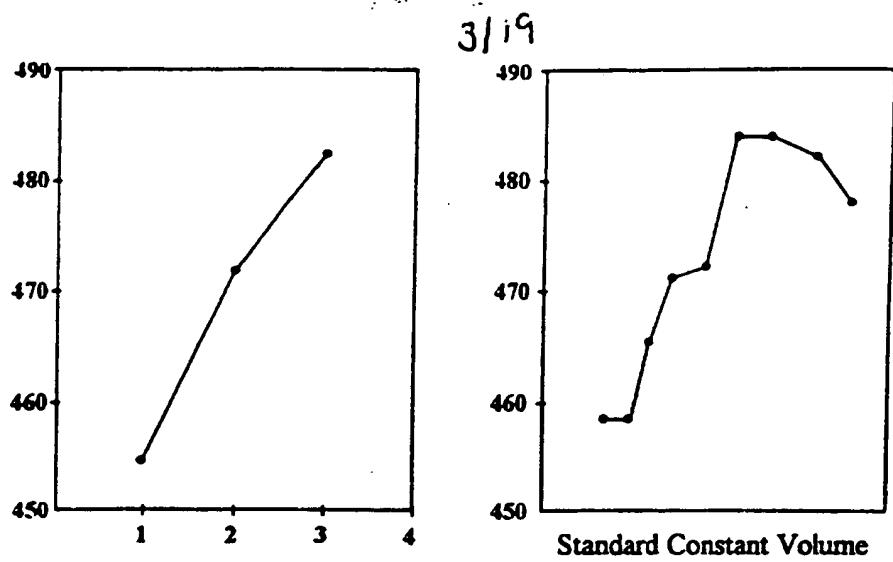


Figure 4

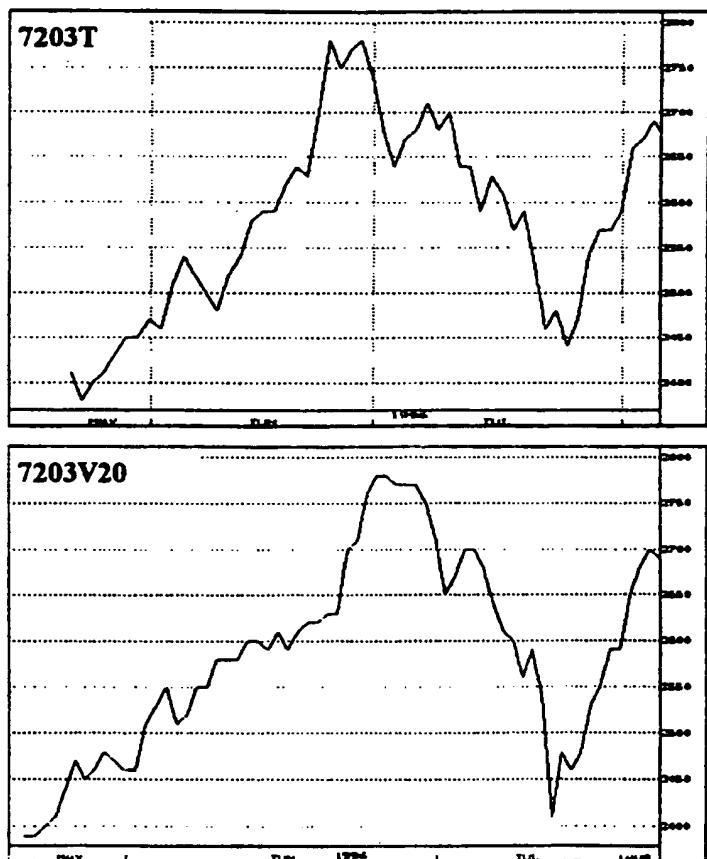


Figure 5

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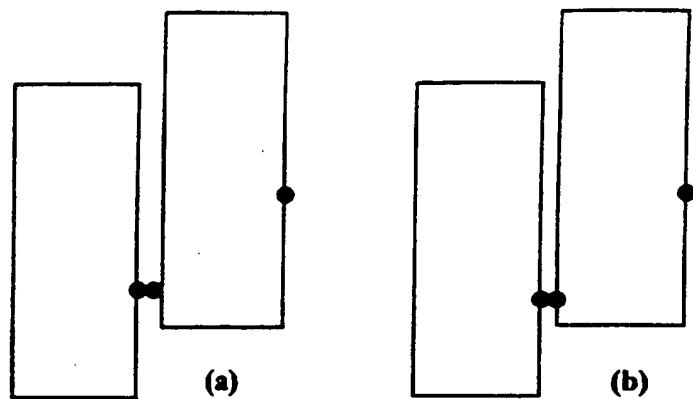


Figure 6

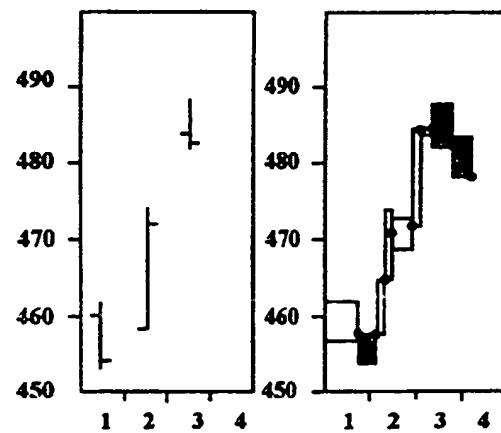
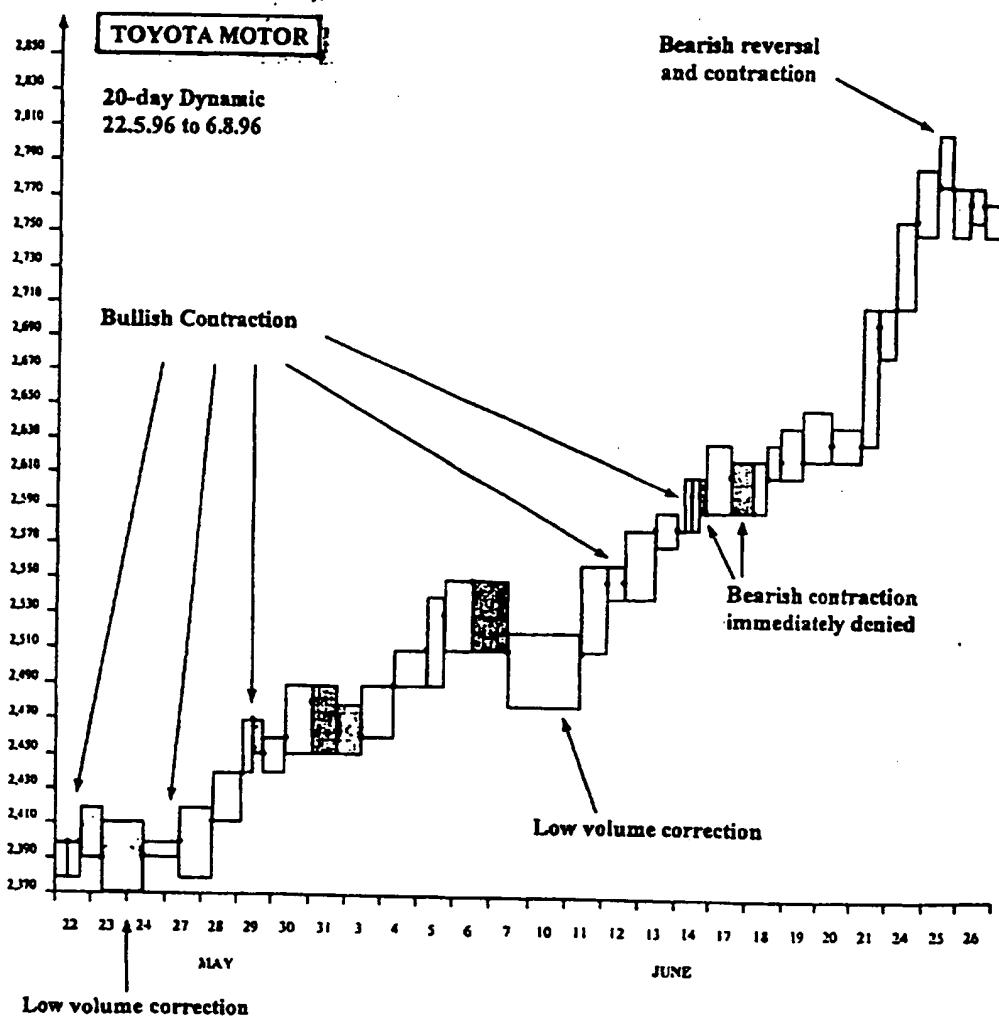


Figure 7

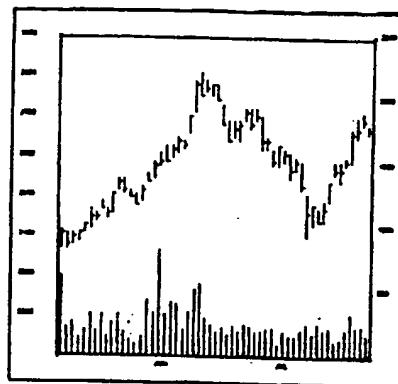
5/19

Figure 8

5a/17 joined to 5b



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Conventional
High/Low/Close/Volume
chart - same period

5b/17

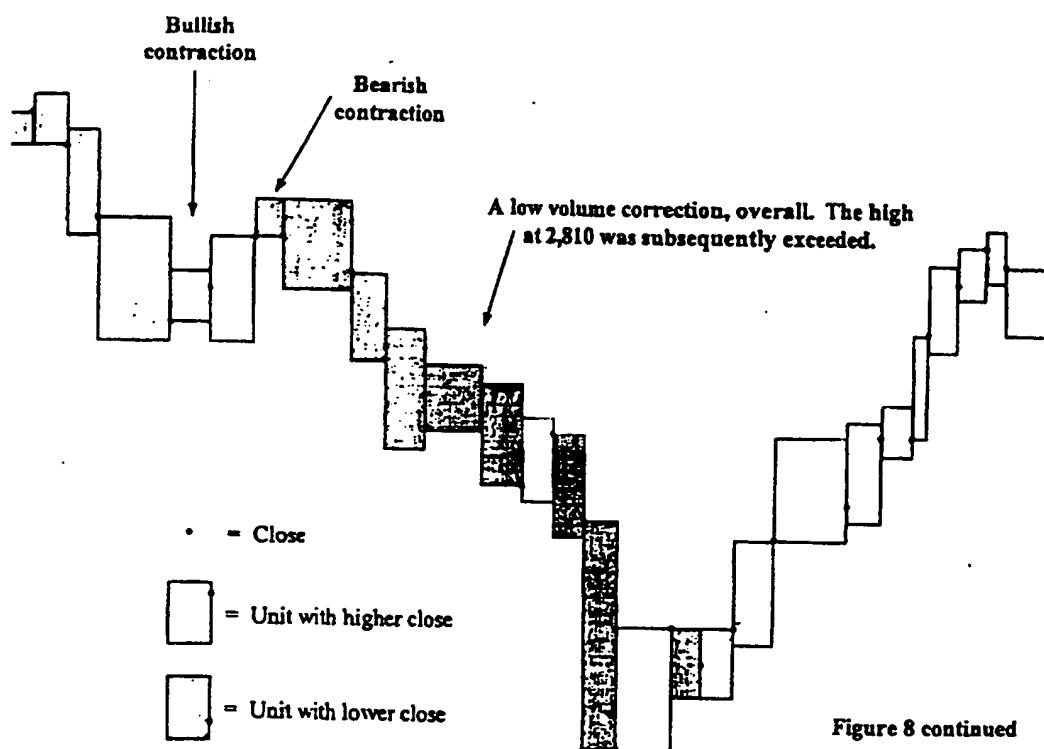
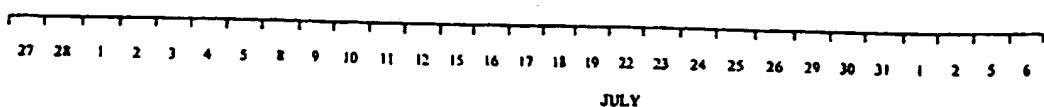


Figure 8 continued



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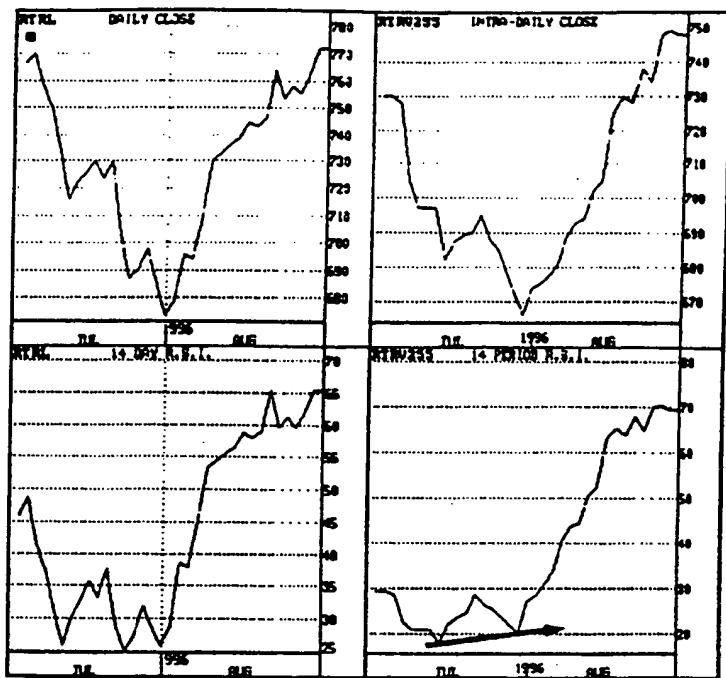


Figure 9

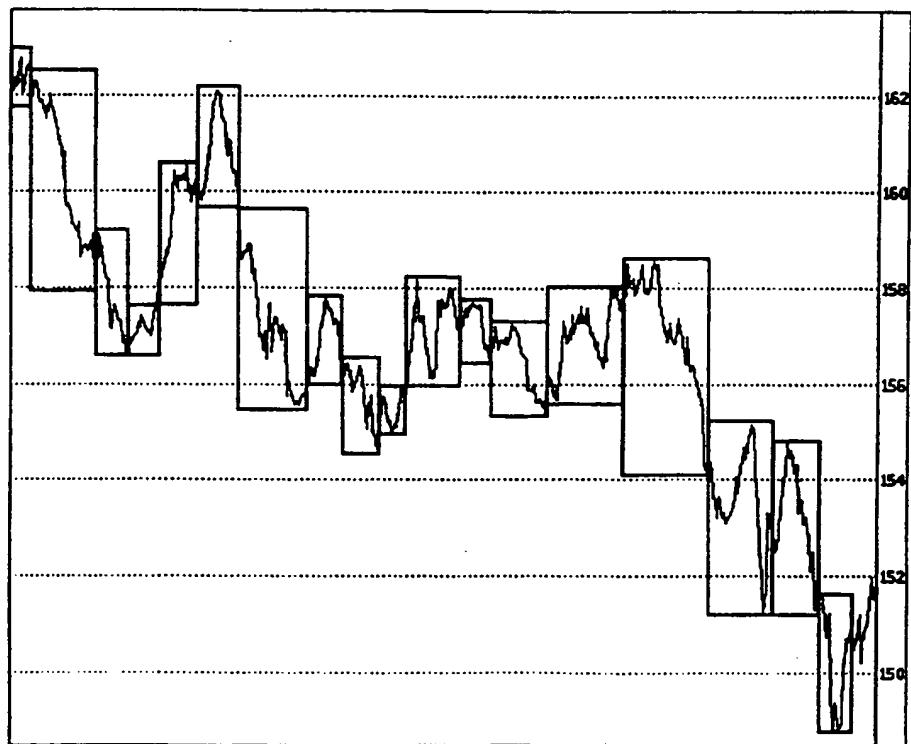


Figure 11

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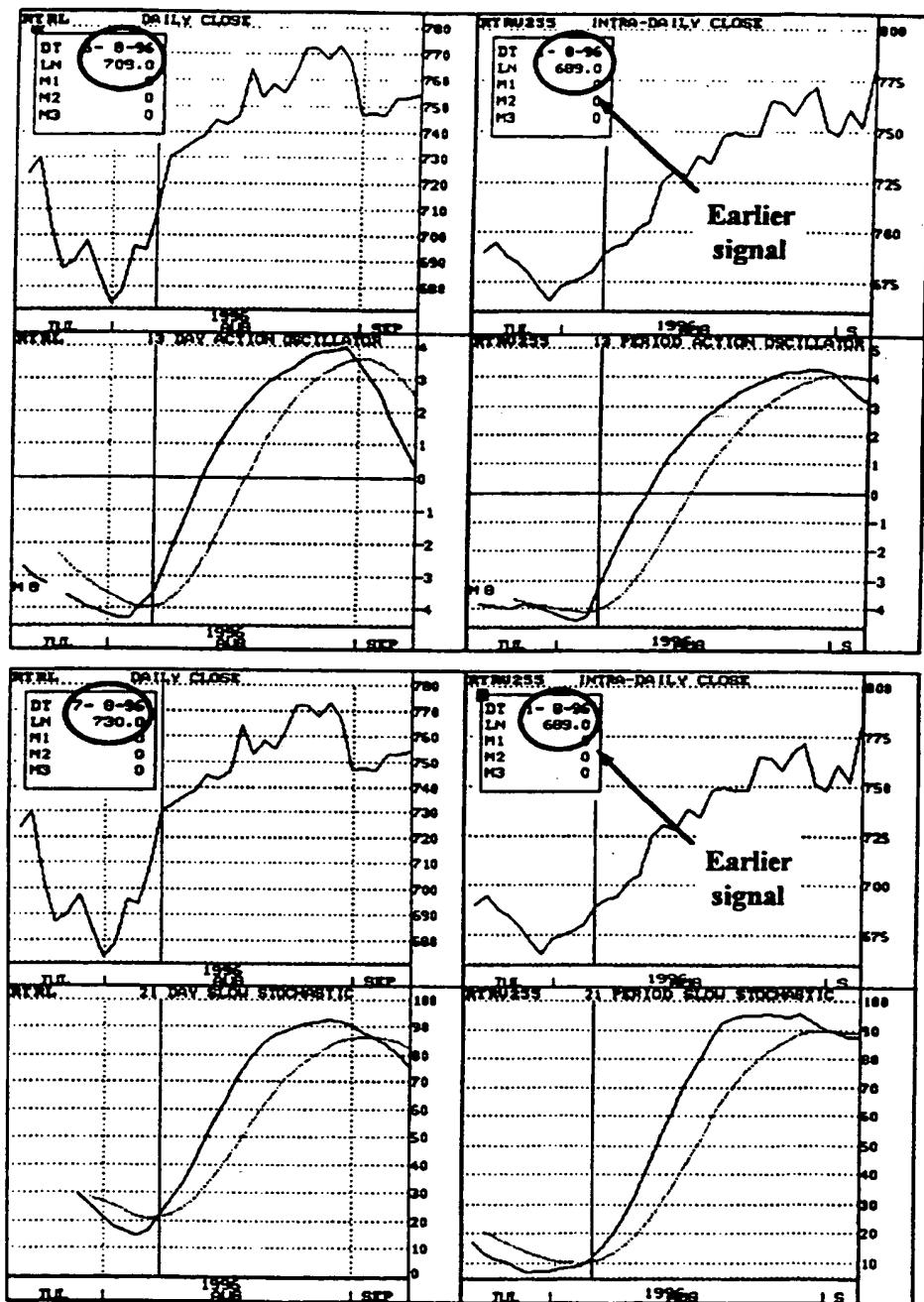


Figure 10

9/19

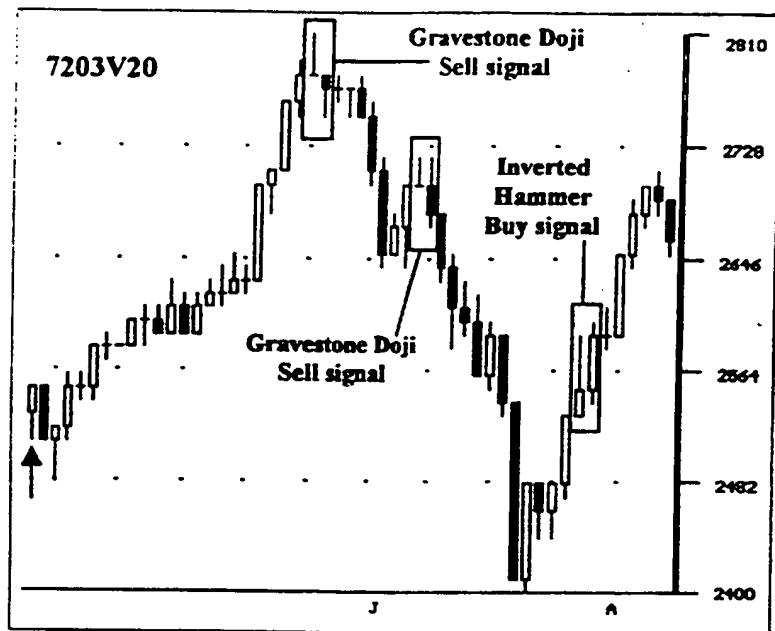


Figure 12

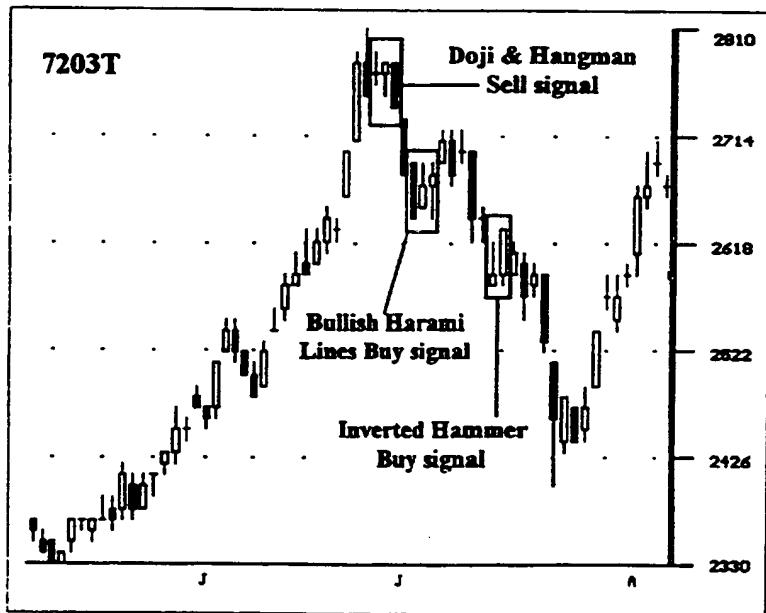
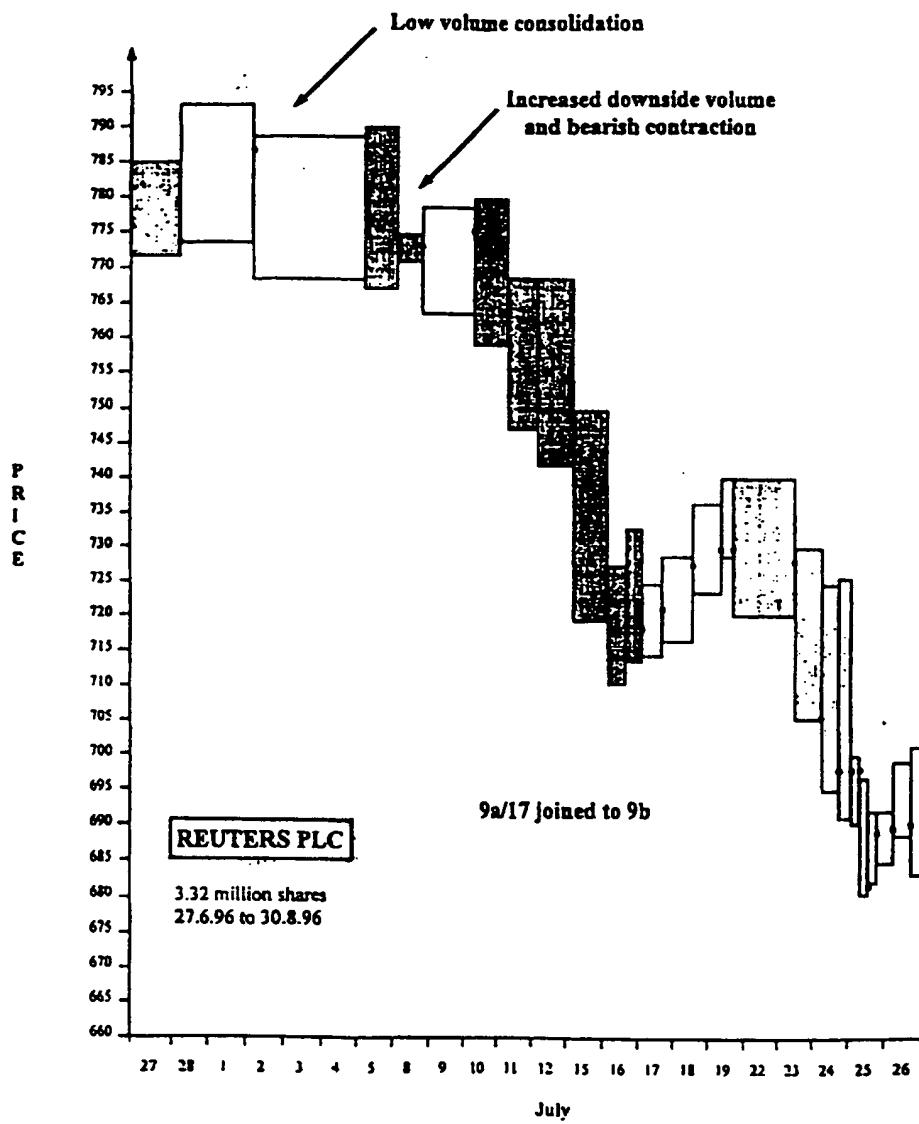


Figure 13

10/19

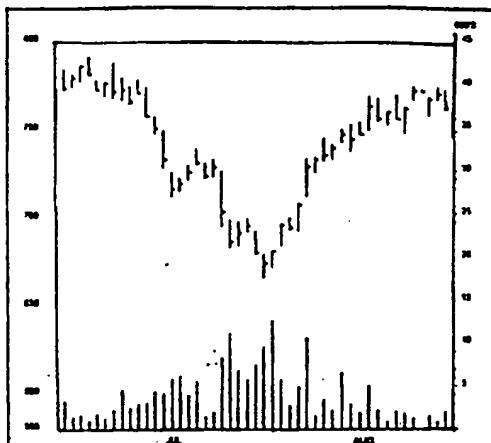
Figure 14

Reuters in Quasi-static format using the daily average volume during 1995.
The bar chart for the same period (27th June to 30th August 1996) is inset.



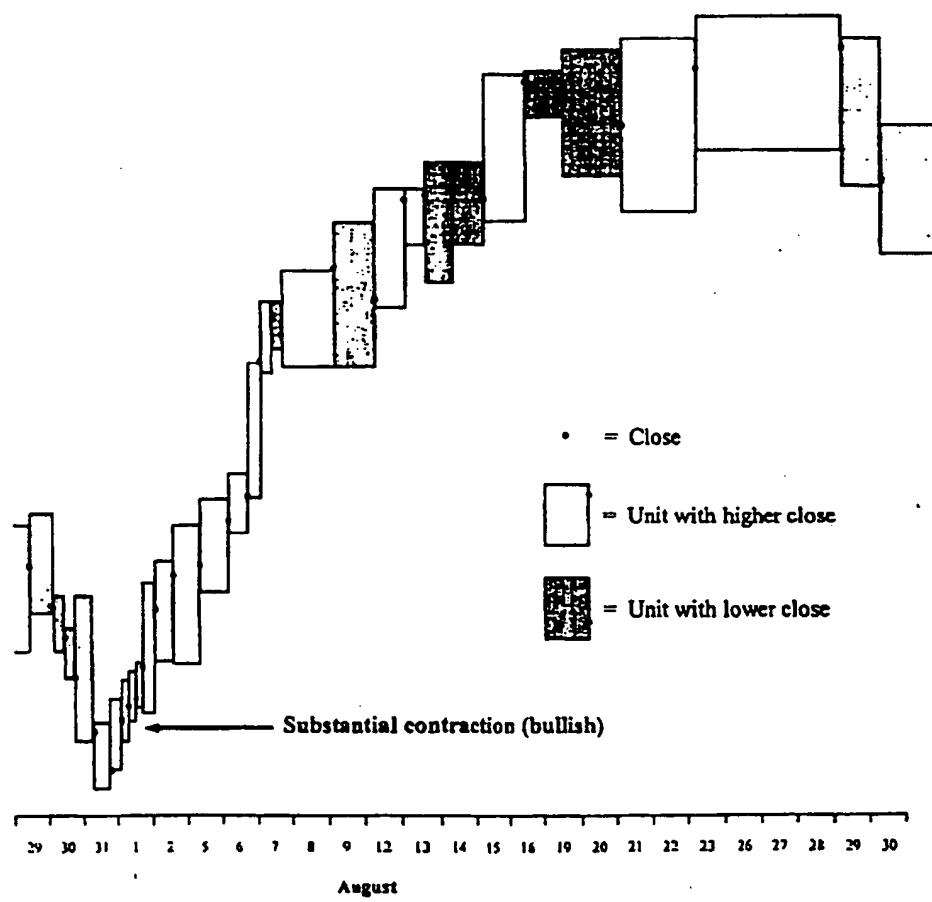
11/19

Figure 14 continued



Conventional
High/Low/Close/Volume
chart - same period

9b/17



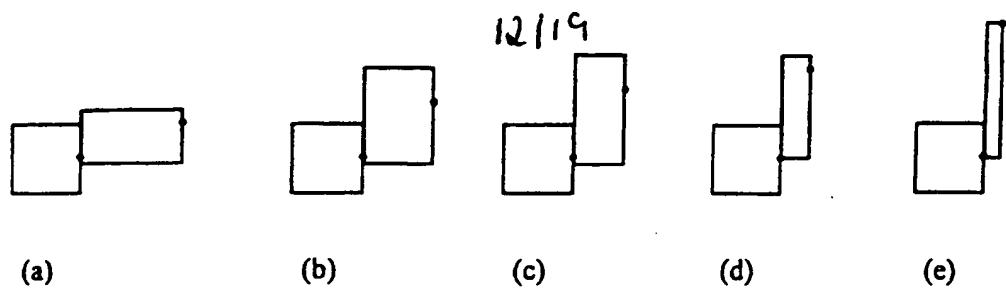


Figure 15

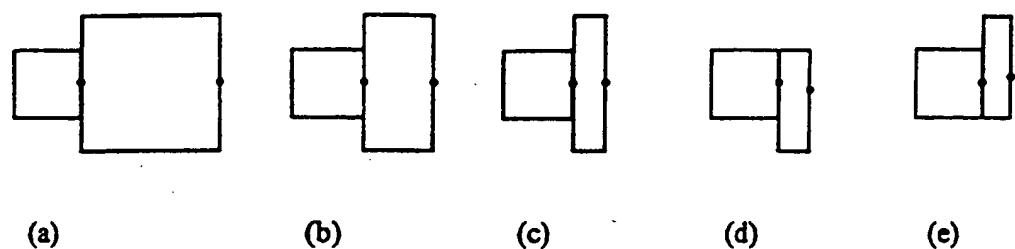


Figure 16

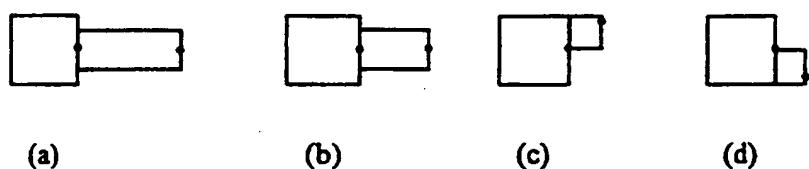


Figure 17

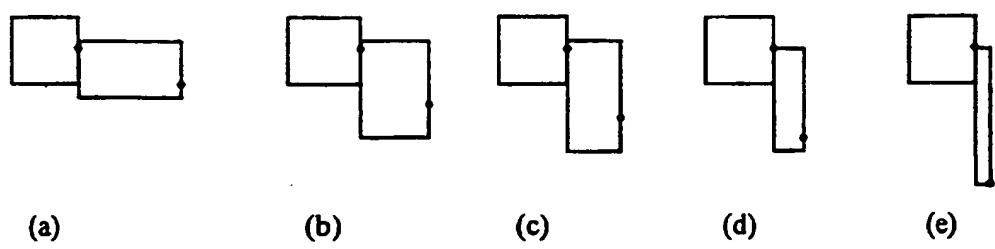


Figure 18

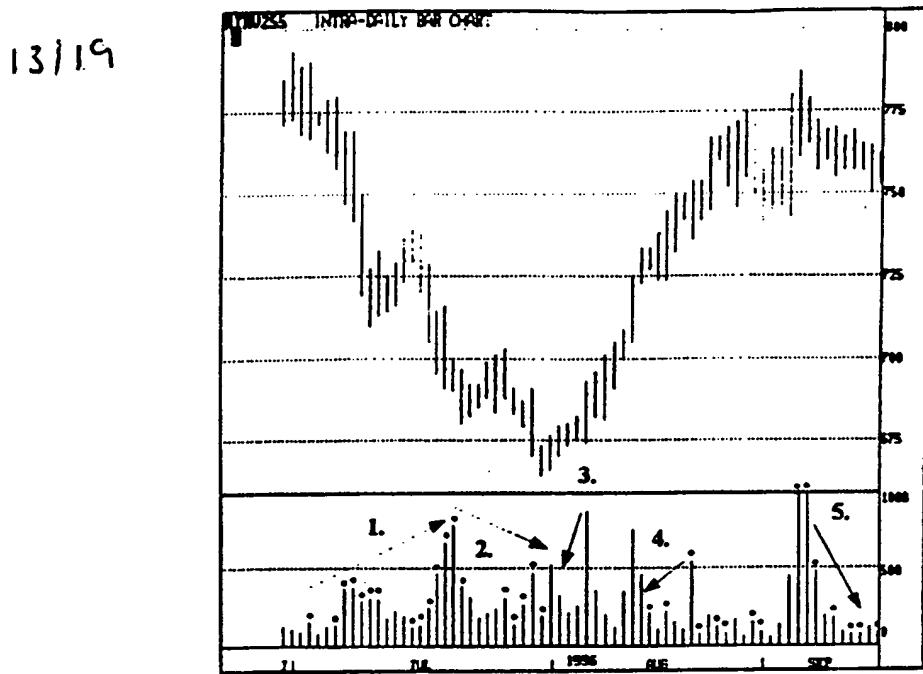


Figure 19

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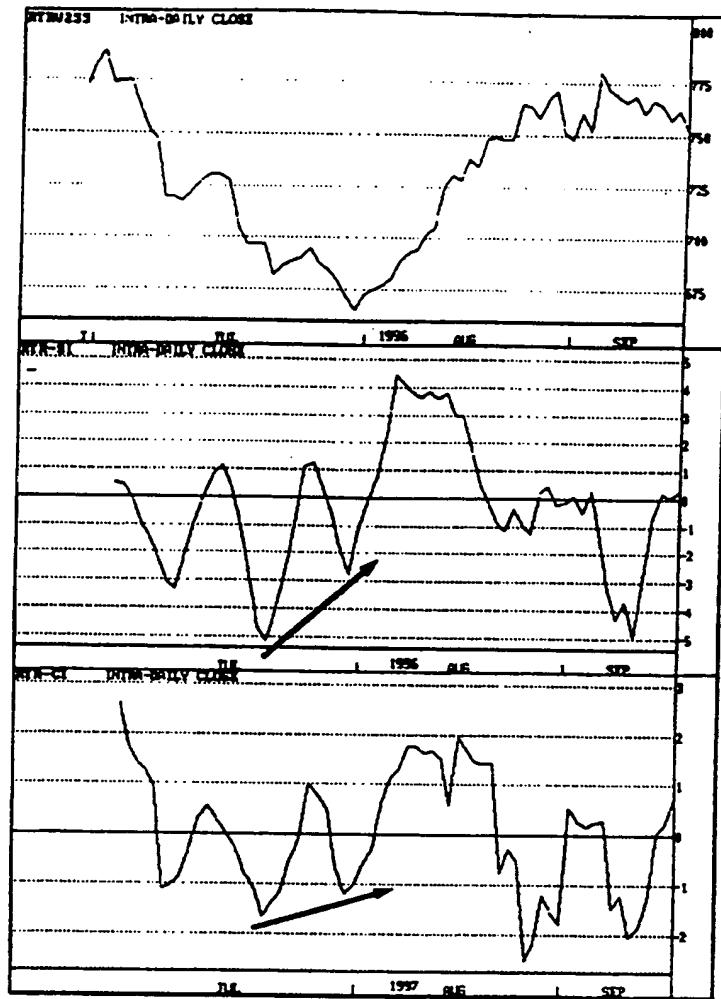


Figure 20

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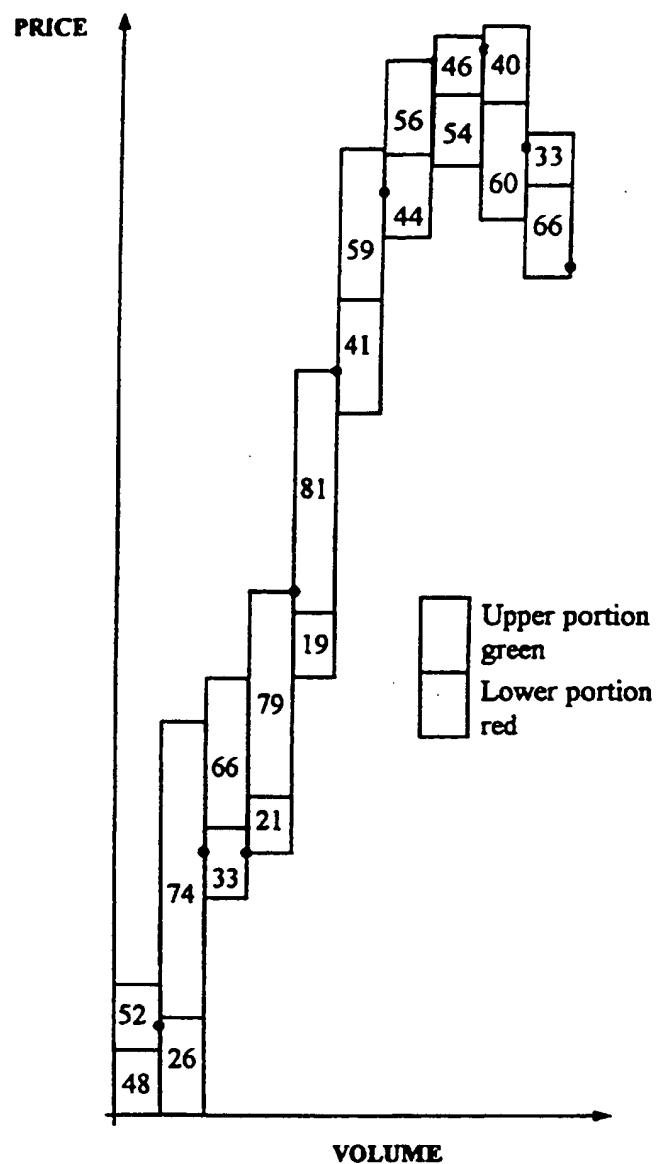


Figure 21

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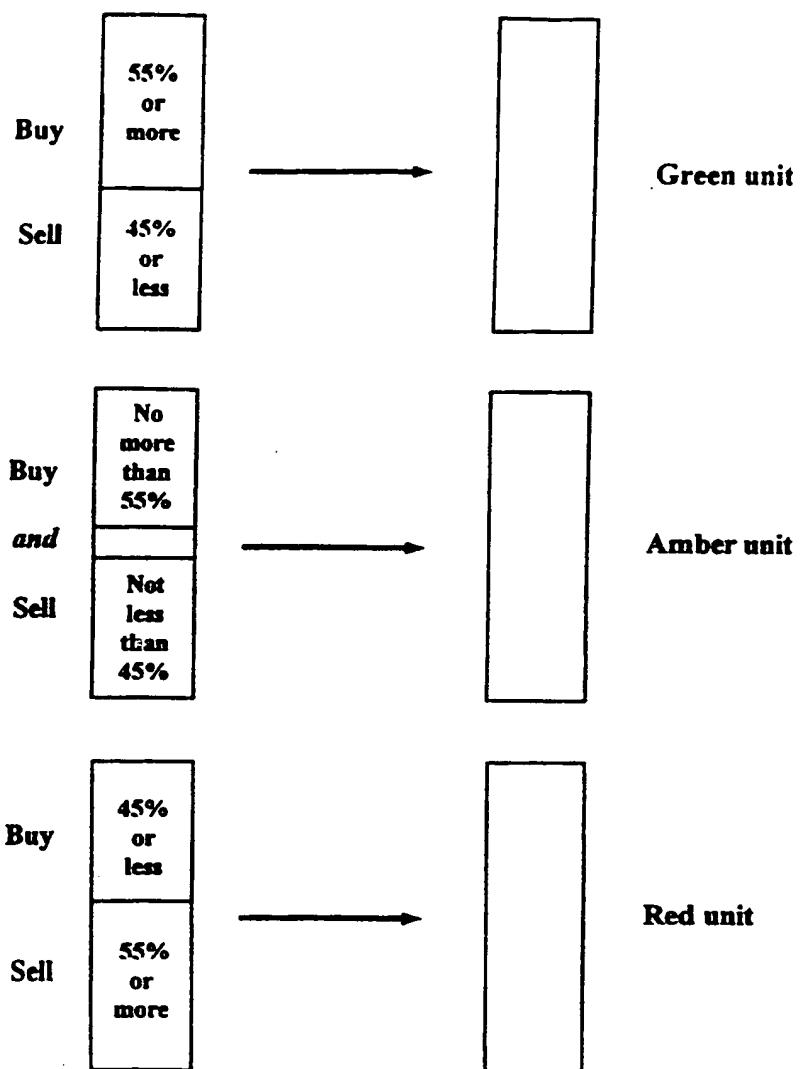


Figure 22

CONFIDENTIAL

Volcon Balance Example - Reuters

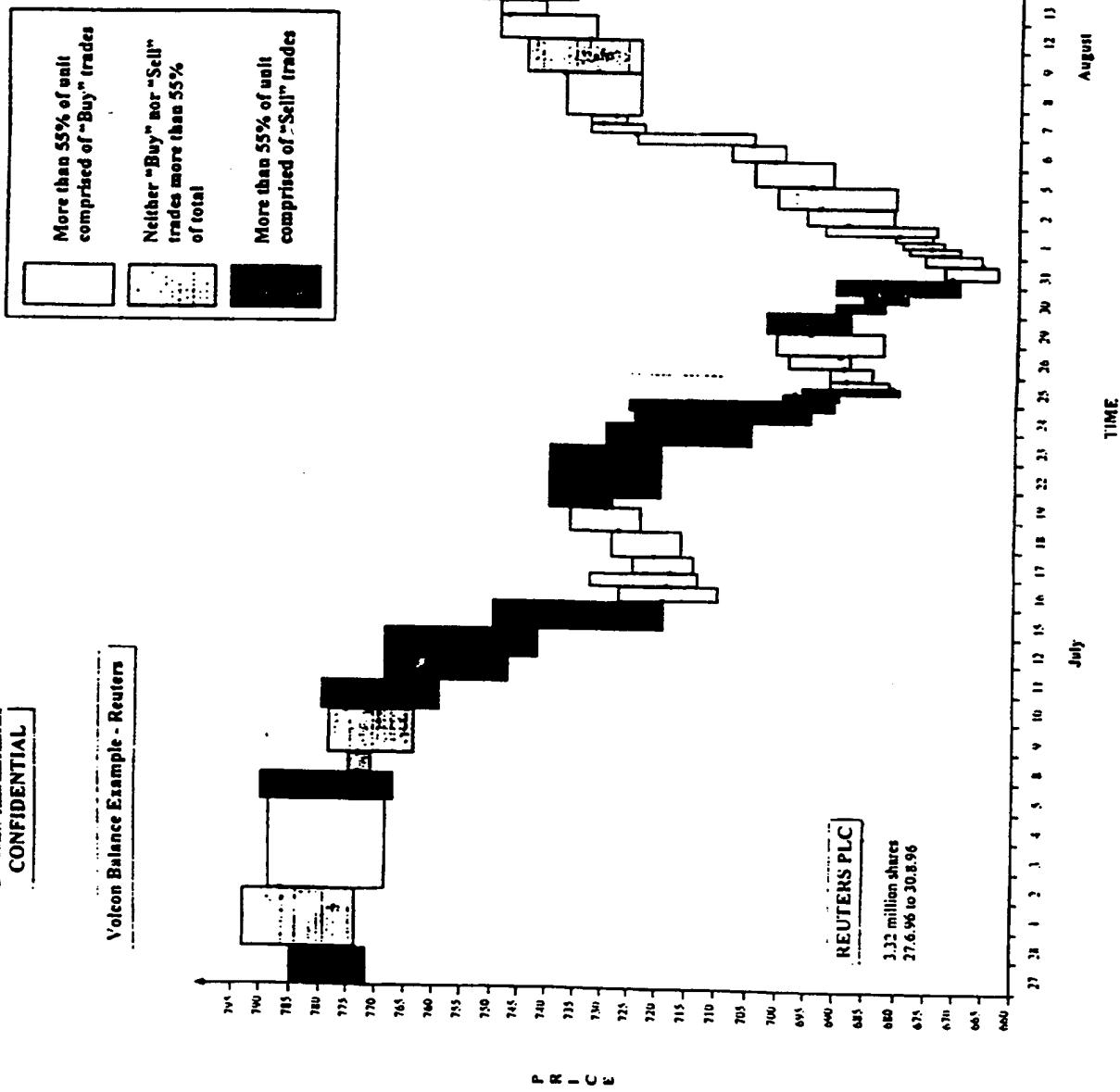


Figure 23

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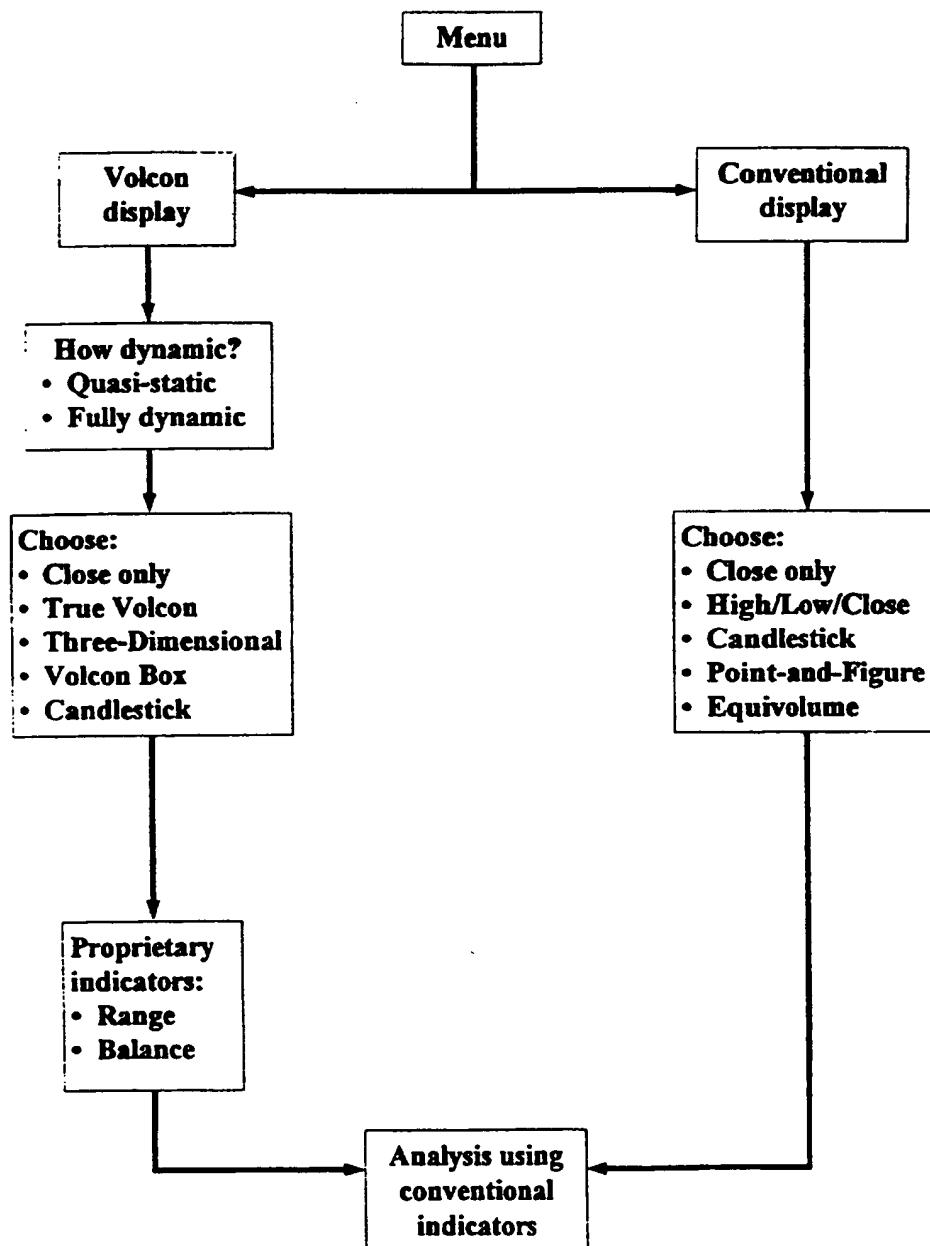
MEDIA SECTOR					
Green		Amber		Red	
Carlton	46%	B Sky B	82%	Reuters	54%
United News	74%	EMI	105%	Pearson	143%
Reed	196%				
WPP	21%	Daily Mail	61%	EMAP	47%
Cordiant	41%	Mirror	62%	Flextech	93%
Capital Radio	98%	Telegraph	65%	Dorling Kindersley	111%
Scottish Media	172%	Trinity	76%	M.A.I.D.	64%
etc.		etc.		etc.	

FTSE
100FTSE
250

Figure 24

19/19

Figure 25



System For The Dynamic Tracking Of Price Movement Of A Traded Commodity

This invention relates to a system for tracking the price movements in a commodity, (which term is used herein not in its technical meaning in the financial sector, but to mean any item, for example a share, bond, currency, or other financial instrument, in which a market exists, and for which it is desirable to track price movements in that market. The invention is particularly applicable to the tracking of share price movements.

For many decades, analysts and traders, technical or otherwise, were content to work with the accepted practice of using the day's closing price as a benchmark for whether it was a "good" or "bad" day in the market, or an individual stock. In more recent years, pressured by commercial considerations and the effects of derivatives on markets, closer attention has been paid to shorter and shorter time frames, until we now have information services which allow us to watch prices "tick" across a computer screen. However, all such charts are generally bound by the convention that price movement is monitored over a unit of time, whether it be a month, week, day, hour, half-hour or an even shorter period.

25

The invention is based on the realisation that this preoccupation with time has obscured some of the signals which can be gleaned from price and volume data.

30 In particular, the invention is based on the realisation that a far more useful picture of price fluctuation in the market can be obtained by determining not the direction and amount of price fluctuation for a fixed period of time, but the direction and amount of fluctuation created by a fixed level 35 of volume. The term "volume" as used herein is used in a broad sense, and may for example indicate the average number of units of the commodity which have been traded during a

preceding period, or is the average value of the units of the commodity which have been traded during a preceding period.

5 The invention provides a system for the dynamic tracking of price movement of a traded commodity, comprising a database for storing details of transactions in the commodity,

means for calculating from the data in the database a volume benchmark, indicative of the average of the volume of the commodity which has been traded during a plurality of 10 preceding time periods,

means for summing transaction volumes in the commodity dynamically to produce a running accumulated transaction total,

15 means for comparing the running accumulated transaction total with the said volume benchmark, and for thereby determining the time period during which a volume of transactions corresponding to the said volume benchmark occurs, and

20 means for providing a graphical visual indication of the said time period, thereby to provide a representation of the level of transactions in the said commodity.

A significant advantage of the method of the invention, as compared with conventional systems of tracking price 25 movements, is that according to the invention, it is not necessary to wait for the end of a fixed time period to establish whether volume has confirmed the price movement. Thus, it is not necessary to miss the early part of a rally, or endure the early part of a decline, because the movement 30 concerned occurs at the early part of a time interval used for monitoring price movement.

The graphical representation preferably includes the price of the said commodity at the start and at the end of the said 35 time period. In a particularly preferred embodiment, the graphical representation includes a rectangle representing each said time period, the height of the rectangle being proportional to the difference between the maximum and minimum

prices of the said commodity over the period, and the width of the rectangle being proportional to the length of the said period.

- 5 In one embodiment of the invention, the volume benchmark may be proportional to (and preferably is equal to) the daily volume of trade in the commodity which takes place over a fixed preceding period. For example, the volume benchmark may be constant for a period of a calendar month, at a value
- 10 corresponding to the average daily volume of trade in the commodity in a preceding a calendar month. Thus, the volume benchmark for each day in February would correspond to the average daily volume of trade in January, and so on.
- 15 In a preferred embodiment, the volume benchmark is a moving average volume of a number of preceding time periods, for example is proportional to (or is equal to) a moving average of the daily volume of trade in the commodity which takes place over a preceding period (for example 30 days)
- 20

The system according to the invention has two distinct advantages over the conventional High/Low/Close/Volume chart:

1. The same amount of buying or selling lies behind every 25 unit of price fluctuation which arises (subject to such minor variation as may arise in the value of the volume benchmark, as explained above). By viewing each unit relative to immediately preceding units in terms of the amount of fluctuation and time elapsed, a user is able to make a more 30 informed judgement about the significance of a price movement as it unfolds.
2. The closing price of a chart unit can occur at any point in time. When volume is higher than average, several units may 35 complete during a fixed time period. This will allow the user to act on that "more informed judgement" earlier than someone who is waiting for the fixed time period to elapse to see if volume confirms.

The time period used for calculation of the volume benchmark may vary, depending on the type of commodity in question, and the time scale in which the user is interested.

5

The system according to the invention employs an appropriately programmed computer to derive the volume benchmark, and to implement the other calculations and manipulations necessary, as well as to display the resulting graphical indication. The 10 particular way in which this is implemented in computer software is well within the capabilities of one of average skill in the art, from the general description herein. In general, this will involve a database to configure real-time data into volume units, and to store details of the said 15 units. The computer system preferably also provides for more conventional analysis methods, in addition to methods employing the system of the invention. Figure 25 is a schematic representation of a suitable user interface.

20 The system of the invention works best as a means of comparing current trading volume in a share or other commodity to its own volume history, so "fixed volume", in the same sense that "a day" is fixed and can be applied uniformly across all stocks and commodities, is meaningless. It thus indicates 25 rapidly when something unusual in volume terms is occurring in a particular stock or commodity. The unit of reference (the volume benchmark) therefore needs to be set in terms of the stock's own normal trading parameters. As indicated above, this may preferably be carried out by one of the two following 30 methods: -

1. The average volume traded during a previous calendar period.
2. A moving average of volume.

35

It will be appreciated that a unit in accordance with the present invention does not have a price close which coincides with a fixed time period, but is based on a volume average

which is time-fixed - i.e. hourly, daily, weekly etc, and which is known as the volume "benchmark".

In the following description, it is convenient to refer to
5 "volume units". As used herein, the term "volume unit" is used to mean a graphical representation which displays the range of fluctuation in price during which a pre-determined fixed level of volume is traded. In preferred embodiments, "volume unit" may also display the time period during which
10 that activity took place.

A preferred method for calculating "volume units" is as follows:

15 a. Total the volume over the previous X periods (hours or days etc.), using the quasi-fixed or moving average duration that has been selected;

20 b. Divide the totalled result by X to obtain the average volume during that time, Y;

c. Every time Y number of shares is traded, record:
- the time of the first trade
- the price of the first trade
25 - the highest price traded
- the lowest price traded
- the price of the last trade
- the time of the last trade.

30 The system in accordance with the invention permits the display of various forms of charts, as will be described in more detail hereinafter. For convenience, reference will be made herein to the following preferred forms of charts in accordance with the invention, all of which are described in
35 more detail hereinafter :-

- "standard constant volume" charts
- "constant volume" closing charts
- "constant volume" three-dimensional charts

- "constant volume" box charts
- "constant volume" candlesticks charts

5 A number of preferred embodiments of the invention will now be described with reference to the accompanying drawings, in which:-

10 Figure 1 is shows trading in a hypothetical investment instrument (HII) which trades only once every hour

15 Figure 2 illustrates a graphical representation method Figure 3 shows Close-only, Open/High/Low/Close/Volume, and True "constant volume" formats for the same HII data as Figure 1

20 Figure 4 illustrates conventional and "constant volume" Close charts for the data of Figure 1.

25 Figure 5 illustrates conventional close (7203T) and "constant volume" close (7203V20) formats for Toyota Motor from 22nd May 1996 to 13th August.

30 Figure 6 shows a method for treatment of volume units which are smaller than individual trade size.

Figure 7 shows the HII example of Figure 1 in bar chart and "constant volume" form using the same scale.

35 Figure 8 is a representation in three-dimensional format of a price movement chart for Toyota for the period shown in Figure 5, using a 20 day moving average. The conventional bar chart for the same period is inset.

Figure 9 illustrates conventional bullish divergence signals and corresponding signals derived from the system of the invention for the data of Figure 14 from the RSI momentum indicator in July/August 1996. RTRL is conventional and RTRV255 is "constant volume" Quasi-static.

40 Figure 10 illustrates conventional cross-over buy signals and corresponding signals derived from the system of the invention for the data of Figure 14 in August 1996. RTRL is conventional and RTRV255 is Quasi-static.

45 Figure 11 shows a security "ticking" across a chart, surrounded by volume boxes to illustrate when the volume benchmark had accumulated.

Figure 12 is a dynamic candlestick chart of Toyota (7203V20) using a 20-day moving average volume benchmark.

Figure 13 is a Conventional candlestick chart of Toyota (7203T).

5 Figure 14 is a representation in a Quasi-static format for Reuters, using the daily average volume during 1995. The conventional bar chart for the same period (27th June to 30th August 1996) is inset.

10 Figures 15 to 18 illustrate: Various buying and selling tendencies

Figure 19 illustrates a "standard constant volume" chart (in bar format) for Reuters with individual Trend Strength readings below. A dot above the TS bar indicates a negative reading.

15 Figure 20 shows a Quasi-static close-only chart for Reuters with

5-day Trend Strength Index (middle) and 5-day Trend Chain Index (bottom).

Figure 21 is an illustration of actual buy/sell percentages,

20 Figure 22 illustrates criteria for colour coding the summary format,

Figure 23 is an example of the summary format, applied to Figure 14,

Figure 24 is an example of the "constant volume" Alert Grid,

25 and

Figure 25 is an Example of a flowchart for the system of the invention.

Referring now to the drawings in detail, Figure 1 shows trading in a hypothetical investment instrument (HII) which 30 trades only once every hour, a simple example will illustrate conventional and "constant volume" data collection and consolidation. The "constant volume" volume average is 1,200,000 shares. Table 2.1 illustrates how the data is compressed into both conventional Bar and "constant volume" charts, and the narrative below explains the process.

The Open/High/Low/Close/Volume data for conventional recording methods needs no elaboration, but a brief description of the

allocation of volume from the individual trades to the "volume units" V1 through V9 will help clarify the construction method.

5 V1: Straightforward. The volume accumulator starts at the open on Day 1, and finds that 1,200,000 shares have been traded by the 2.00 p.m. session.

V2: The unit commences with the 3.00 p.m. session, and
10 750,000 shares are carried forward at the end of Day 1. During the 9.00 a.m. session, of Day 2 the V2 unit completes. Of the 700,000 shares traded in that session, the accumulator adds 450,000 to the 750,000 brought forward to make
15 the 1,200,000-share unit, and 250,000 are carried forward to V3.

V3: This unit comprises the 250,000 brought forward, the 600,000 shares traded at 10.00 a.m. and 350,000 shares from the 11.00 a.m. session. From that latter session 650,000
20 shares are carried forward to V4.

V4: To the 650,000 brought forward, 450,000 are added at 12.00 a.m. and a further 100,000 at 1.00 p.m. to make up 1,200,000. Of the 300,000 at 1.00 p.m., 200,000 are carried
25 forward to V5.

V5: The 200,000 brought forward, plus 200,000 at 2.00 p.m., plus 500,000 at 3.00 p.m. and 300,000 from the final session total 1,200,000, making the conventional and "constant volume"
30 closes both 472. The unused 400,000 from the 4.00 p.m. session are carried forward by the accumulator to V6.

V6: This completes immediately at 9.00 a.m. on Day 3, leaving 200,000 shares to be carried forward to V7.

35

V7: This comprises 200,000 shares from 9.00 a.m., the 650,000 traded at 10.00 a.m., and 350,000 from the 11.00 session, with 250,000 shares carried forward.

V8: This comprises 250,000 brought forward, the total volume at 12.00, 1.00 and 2.00 p.m., as well as 100,000 of the volume from the 3.00 p.m. session. This leaves 500,000 to be
5 carried forward by the accumulator.

V9: To the 500,000 shares brought forward are added the 400,000 from the final session on Day 3, plus the total volume from the first two sessions on Day 4.

10

And so the process goes on.
This is a simple example, but already we can see several facets of the "constant volume" method according to the invention.

15

- The use of a computer is essential in order to track and calculate the necessary quantity of trades in real time.
- "constant volume" keeps you up-to-date with events. During 20 three days of trading, there were three "updates" from conventional charts against eight from "constant volume".

The higher-than-average daily volume on Day 1 (1.95 million versus 1.2 million shares) would have put the conventional 25 analyst on alert, but only on Day 2 would he have seen the really big volume come in. "constant volume" began to warn him on the afternoon of Day 1, and by 10.00 a.m. on Day 2 he would really have been paying attention.

30 - "constant volume" is a simple way of volume-weighting a chart. The weighting is the same in each reading, but they come more often during periods of high volume, and therefore are more timely than end-of-period weighting methods.

35 - There are few gaps in the data. This is a result of the construction method, and only when a unit coincidentally closes at the end of fixed time period,

which is itself then followed by a gap, will a gap appear in the "constant volume" chart. If gap analysis is required, conventional charts can continue to be used for this.

5

" Standard Constant Volume" Charts

10 In the world of conventional charts, time is fixed, whilst volume is variable. With "constant volume", time is variable and volume is fixed.

15 Conventional charts treat time as a constant along the x-axis, with price (and volume) displayed on the y-axis, being variable on a daily basis. In accordance with a first embodiment of the invention, referred to herein as "standard constant volume charts", price remains the y-axis variable, but the x-axis constant becomes volume. Specifically, the volume units along the x-axis represent the average number of shares traded in a pre-determined previous time period.

20

As with a Bar chart, "standard constant volume" charts plots the High/Low range which evolves whilst the volume unit is being completed. Like candlesticks, True charts have a "real body", which will usually take the visual form of a rectangle, 25 having the height of the daily range. In the right-hand wall of the rectangle the close is represented by a dot, as illustrated in Figure 3.1. The width of each box is uniform, and will depend on what is convenient to the user. As with candlesticks, it is useful for the colour of the rectangle to 30 signal the direction of the period's trading.

For example, in accordance with a simple set of rules:-

1. A simple unit with a higher closing price than the previous 35 unit is white, irrespective of their range of trading.

the closing price is lower than the previous unit, the is shaded grey (so that the closing dot still stands also irrespective of the range.

the two closing prices are the same:

) The second unit is white if:

(i) The second unit has a higher high, but not a lower than the first unit.

(ii) The second unit was either an outside or an inside compared with the first unit, and the mid-range price of second unit was above the close of the first unit.

The second unit is grey if:

(i) the second unit has a lower low, but not a higher than the first unit.

(ii) As (a)(ii), but the mid-range price was below the of the first unit.

2 illustrates the combinations of Rule 3.

3 illustrates the example HII data set out in Figure 1 in Close-only, Open/High/Low/Close/Volume, and "standard nt volume" formats to provide a brief but immediate ison.

l be illustrated below that the "constant volume" form resentation is capable of generating a real-time chart provides significantly improved visual clarity of market pments.

constant Volume" Close Chart

1 illustrates how all of the elements of a "constant chart are mathematically derived. It can be seen that element of a "constant volume" chart mirrors the ow/Close of a conventional Bar chart. However, unlike a art, where the close occurs after a fixed time period

The above paragraph also explains why the time scales do not match up despite covering the same calendar dates - the same calendar period will contain differing numbers of "constant volume" and conventional closes.

5

"constant volume" Close and indicator configurations:

One important reason for having a flexible x-axis with "constant volume" Close charts is to avoid losing visual 10 detail when high volume bunches up the closes (Figure 9). Perhaps more importantly, it retains a convention which will help when we look at indicator configurations for signals.

We are used to seeing charts where the plots are evenly spaced 15 to reflect the passage of equally spaced time units. We are therefore accustomed to a particular type of momentum configuration when looking for indicator divergence as a warning of a reversal. If we do not space out the "constant volume" closes at the same intervals as we are used to seeing 20 in conventional charts, we may have greater difficulty in recognising any equally valid "constant volume" momentum configuration which occurred during high volume. Higher-than-average volume produces more closes bunched more tightly together in time, making conventional patterns more difficult 25 to discern.

Some unusual situations:

There are a few unusual situations, which are worth 30 considering:

1. The volume of a single trade is bigger than the volume average being used.
- 35 This only matters when the trade is not used to complete a previous "volume unit", or when having done so the volume left over is still bigger than the average. The solution is simple. Since the open, high, low and close all occur

instantaneously, they are represented by the usual closing dot, alongside the previous closing dot. This is illustrated in Figure 6. In the likely event that there is still some unused volume from the trade, the left hand boundary of the 5 next "constant volume" box unit will overlap the dot (Figure 6).

2. A new volume average is so much smaller than the previous one that it appears to leave a prematurely finished unit.

10

Because "constant volume" works on calendar-based volume units, but volume-based price units, the switch from one volume average to another as part of the dynamic process can create unexpected problems. For example, if a 1,000,000 share 15 average is used, and as a week's trading ends a "volume unit" is incomplete at only 950,000 shares. 50,000 shares therefore need to be traded in the next week before the "volume unit" completes. However, on the following Monday a new average is calculated, and shows that now only 920,000 shares should be 20 used for each "volume unit". What do you do with the 950,000 box? It is too small based on last week's average, and too big for this week.

25 The rule is simple. Always complete a "volume unit" that has been started, using the average volume at commencement. Never switch to a new average until a unit is complete.

30 3. A stock has a scrip issue (split)/a rights issue/issues a dividend in shares (the event).

There are two ways of handling this, depending on the intended use of the "constant volume" chart.

35 The first is to select a recent "constant volume" Reference Point briefly recalculate the pre-event trading to adjust it to the same basis as post-event trading, and start the chart from scratch.

"unit" are used in this method of display, and too small an x-axis scale will bunch up the units when volume levels are high.

- 5 Taking the hypothetical investment instrument (HII) example from Figure 1, it is easy to see from Figure 7 how what would be an over-generous time-scale for a Bar chart is a little cramped for the "constant volume" version.
- 10 The downside of using V3D charts is that they do require additional space. This should not be a problem for the analyst, because only the detail of the more recent units is of interest for the purposes of relaying signals.

15 Dynamic "constant volume" Three Dimensional

Figure 8 illustrates the 3-D version of Toyota, covering the same time period as the previous 7203T and 7203V20 charts. The Toyota conventional bar chart is inset for comparison.

- 20
- 25 The representation of Figure 8 is in some respects similar to a conventional daily bar chart. This is because 7203V20 is based on a 20-day moving average of daily volume. It is therefore as directly comparable to the inset bar chart as the two techniques allow.

- 30
- 35 The use of the volume moving average means that the volume benchmark that is the basis for dissecting the trade-by-trade data to create the "volume units" is continually changing to reflect market activity. However, the smoothing process involved in the moving average method means that the effects of volume changes are, nevertheless, gradual. Only when very short periods are used is there the risk that one day of very high or very low volume will temporarily distort the perspective which "constant volume" charts provide.

Despite the small increasing or decreasing differences created by using a 20-day average rather than a quasi-fixed method of

construction, the volume of trading in each box is still approximately the same as in the preceding box. We therefore have a real-time dynamic perspective which is different from real-time conventional charts.

5

By substituting the volume unit for the time unit, the "constant volume" chart provides the better perspective of the two. Not only does it allow the user to see immediately when activity starts to build up, but it also allows them to make a 10 comparison of the effect that current volume is having with immediately preceding volume units, in terms of both price fluctuation and time elapsed. In effect, it answers the question in real time: 'How important is this move?' - albeit on a subjective basis.

15

Unit Contraction and expansion

When we look at a conventional high/low/close/volume bar chart, we can all identify the high volume advances and 20 declines; the rises and falls that are quickly retraced because they were accompanied by low volume; the consolidations, tops or bottoms where high volume signified disagreement between the bulls and bears; the turning points where lower volume compared with previous extremes in the 25 trend revealed exhaustion. But how did it look in real time?

Configurations at tops and bottoms are discussed below, but the visual comparison of a "volume unit" with its preceding units is an important facet of the improved perspective that 30 this method provides in mid-trend. In an uptrend, the analyst will want to see contraction in the overall box size/range to confirm that volume is continuing to push prices higher. During the inevitable pauses along the way, expansion of box range will occur, indicating that volume is low, and it is 35 therefore taking time for the unit of trading to be completed.

In the case of Toyota in Figure 8, there are several instances worth highlighting. It was unfortunate that we started data

collection on 22nd of May, because the bullish range contraction occurred after 39 trading days of sideways movement in the 2,330 to 2,400 area, and this was a good indication that volume was building prior to a break-out.

5 Contraction also appeared on 24th May and in earnest on the 29th, although there was some two-way pull evident. The period of 7th through 11th June stands out as an obvious example of a low volume correction. Bullish contraction is again evident through to the 14th June, whilst the bearish

10 contraction on the 17th was immediately denied on June 18th. Here is a good example of when it would have been important to check the momentum and trend indicators for bearish divergence.

15 Thereafter, the bearish reversal of the 25th stands out as the most important signal. Despite the fact that average daily volume had been rising for a month, increasing the amount of volume needed to make up a "volume unit", the three units which appeared on the 25th and 26th June were all smaller than

20 (or no more than equal to) the preceding eight units. Selling had begun.

Bullish contraction appeared on 14th July, subsequent to the sizeable unit of 1st through 3rd, signalling the potential for a rally. Note, however, the significant contraction in the

25 unit which completed on the 8th, warning of a possible downturn. As will be shown later, both this unit and that of 25th June were bearish Gravestone Dojis on the 7203V20 candle chart.

30 Thereafter there were no signals of significance through to the end of the correction.

Quasi-Static Three-Dimensional

35 Figure 14 is an example of a chart of this type, and illustrates Reuters plc between June 27th and 30th August 1996. The volume benchmark used was the average of the daily trading volume for the whole of 1995 - 3.32 million shares.

This means that unlike the Toyota example above, every single unit in this chart is made up using the same amount of volume. Periods of inactivity have produced big wide-ranging units, whereas high levels of activity have produced narrow units,

5 although some of these are also quite deep.

By far the most outstanding feature of this chart is the very heavy buying on 1st August. Three separate units completed that day, and would have warned any "constant volume" watcher

10 at the time that something important was happening. As will be seen later, unlike at the time of the slightly larger white unit on 25th July, the momentum and other "constant volume" indicators had started to give off buy signals at this point.

15 One other feature of this period was the large white units of early July and late August. These units showed that there was a clear lack of buying interest in the 750-800 range during these periods. When selling came in to produce grey units, note how they are narrower implying greater activity. This is

20 interesting with hindsight, because Reuters topped in October 1996 at 806p closing, so the "constant volume" chart covers a period of the distribution of Reuters by longer-term sellers. This chart therefore illustrates in practice the theoretical idea that since the majority of important tops are slow

25 rounding affairs, "constant volume" should produce large white units as buying volume is slowly exhausted.

The inset chart in Figure 8 shows the conventional bar format for the same period. Whilst some of the same messages can be

30 gleaned from that format, the visual impact does not match that of the "constant volume" chart.

Conventional indicators with "constant volume" charts

35 "constant volume" charts have a significant volume-weighting effect on existing momentum indicators. The effect comes from the fact that, because volume is constant between "volume units", when activity is greater than average, "constant

volume" closes occur more often than conventional closes, and in direct relation to the volume levels.

Figures 9 and 10 compare the results of three different 5 indicators around the low in the Reuters quasi-static chart at the end of July 1996. In each case the "constant volume" Reuters chart is on the right and the daily close chart is on the left. Figure 9 compares the 14-period RSI, and there is a slightly clearer bullish divergence pattern in the "constant 10 volume" example compared with the almost flat pattern of the daily close version. (Limited data prevents more of the chart from being shown).

In Figure 10, the cross-over signals of Indexia's 13-period 15 Action Oscillator by an 8-period moving average, and the cross-over of the 21-period Slow Stochastic indicator is compared between the two types of chart. Because volume was picking up in early August, the "constant volume" versions 20 bettered the conventional signals to the tune of 2.9% and 6.0% respectively.

"constant volume" may only give better signals when volume is above average. However, when volume fades in a consolidation it may also avoid producing whipsaw signals before the trend resumes. It is possible to ascertain by empirical testing 25 whether inter-changing between "constant volume" and conventional charts according to volume levels enhances overall returns.

The "constant volume" Box

30

This is a simple extension of V3D, which allows a trader to watch the real-time chart "tick" across the screen, but still monitor the "constant volume" chart at the same time.

35 Instead of drawing a "volume unit" once it is complete, the real-time trade-by-trade chart has the outline of the unit superimposed over it from the second the new unit starts to form. The trade-by-trade line chart meanders its way across

the trader's screen, but it is continuously enveloped by a three-side rectangle representing the high/ low range of the unit. Only when the constant unit of volume is achieved will the rectangle snap shut, informing the user that the building 5 of a new unit is about to start.

Not only can the user see the minute detail of the latest unit's trading, but its significance in terms of volume will also be immediately assessable.

10

"Constant Volume" Candlesticks

The components of a "volume unit", listed above can readily be turned into candlestick form. Whilst the signals can be 15 displayed in "standard constant volume" scaling format, where all the candles will be the same width and the patterns more easily analysed, V3D candles are particularly advantageous because of the time perspective, to which we are all much more used. Unlike conventional candle charts where small candles 20 tend to have less significance, a small "constant volume" 3-D candle means greater activity and therefore potentially greater significance.

Figure 12 illustrates the sell signals which appeared in the 25 7203V20 chart as Toyota topped in June 1996. A Gravestone Doji occurred as the absolute high candle, with a Bearish Hangman acting as confirmation in the next unit. Eight candles further on a second Gravestone Doji appeared, producing a sell signal at the top of the secondary rally. 30 These signals were confirmed at 2,770 and 2,680 respectively by the ensuing black candles.

Compare in Figure 13 the results of using the equivalent daily closing chart. A Doji and Hangman sell signal was confirmed 35 by the close of the fourth day after the top, at 2,740 (30 points lower than the first "constant volume" signal). A Bullish Harami Lines buy signal occurred two days later at 2,680, and was never negated by a confirmed sell signal. A

further buy signal occurred at 2,630, and although these signals subsequently went on to be profitable, it was only after a decline to a low of 2,400. The "constant volume" candle chart later gave an Inverted Hammer buy signal at 5 2,590.

This example demonstrates that there are clearly circumstances under which "constant volume" performs in a superior manner to conventional candles.

10

"Constant Volume" Reference Points

There is one aspect to a "constant volume" chart which requires slightly greater thought than with a conventional 15 chart - its starting point. It is possible to start drawing a conventional chart at the beginning of any month, week, day or hour, and the subsequent high, low and closing prices will always be the same even if the start had been one time unit earlier or later. This is not so with "constant volume".

20

The easiest way to visualise the difference is by imagining that instead of charting the daily high, low and close between 8.30 a.m. and 4.30 p.m. (or whatever are the official hours of the Exchange in question), the chart is constructed using the 25 range of fluctuation between 9.30 a.m. on one day to 9.30 a.m. the next. The two charts would look different, although over longer periods of time their range of fluctuation would be almost identical. To do other than use normal Exchange hours seems nonsensical, because the natural tendency is to think in 30 terms of the daylight hours provided by the solar cycle, which provides a natural delineation of our economic activity between one day and the next. However, if time is removed, one long flow of market trades in a stock remains, and there are no natural breaks to help decide where to start the 35 accumulation of the first "volume unit".

An Example

The practical effect of this is easily illustrated by reference to Figure 1. If unit V1 had started at 1.00 p.m. on Day 1 instead of 9.00 a.m., the accumulation process would have been out of phase by 700,000 shares. By the time unit V8 5 is reached, this has pushed the process forward to the extent that V8 will close not at 3.00 p.m. on Day 3, but at 10.00 a.m. the next day. This is because it needs the 400,000 shares from the 4.00 p.m. session, the 200,000 shares from the 9.00 a.m. session and the 100,000 shares from the 10.00 a.m. 10 on Day 4. The analyst watching the original phase would have seen a grey unit complete with a lower close on Day 3 (illustrated in Figure 3), whereas someone watching the 700,000-share shifted version would not get the signal until Day 4, when the price was lower.

15

This does not mean that the originally constructed chart will always produce earlier signals, only that the two will always be 700,000 shares out of phase. Which chart produces the best signals will depend entirely on the subsequent pattern of 20 trading, but the point about where to "anchor" the chart needs to be addressed formally.

Solutions

25 There is a range of solutions from "ideal" to "practical".

Every share has its own price cycle, heavily influenced by how 30 its own commercial performance, and the performance of its industry, relates to the overall economic cycle. Ideally, the "constant volume" chart should commence with the trade which marked either the absolute high or low price of the last long-term cycle in market terms. Each share should be individually analysed for its ideal starting or "reference" point.

35 This process is obviously not necessary if the "constant volume" user has a shorter or very short investment or trading horizon. Depending on this perspective, the reference point can be set at the trade which marked the high or low point of

the price cycle which is relevant to the user. For example, a short-term trader who might be "long" of a stock for no more than a few days, and would then be prepared to go "short" for a correction, would perhaps view the cycle to be no more than 5 three or four weeks long. That trader's reference point might be set only days prior to the date at which he wanted to trade, particularly if he used a relatively small volume benchmark. This is an aspect of using "constant volume" which is discussed again below.

10

Whilst the latter scenario might be realistic for a user working from time and sales data, because of a short time horizon, it is not practical where the user wishes to start collecting or displaying "constant volume" data for hundreds 15 of different shares at a time, particularly with respect to initiating storage in a new database. The solution in this instance is simple - pick a date, preferably a significant one.

20 This practical solution is perfectly acceptable, because the end result achieved is not going to be radically different from a different date selected by another method. Whilst there is the intellectually satisfying "ideal" discussed above, with "constant volume" there is no "right answer" in 25 quite the same way that we have for what trades go into a daily or weekly chart, which are temporally delineated.

The alternatives, in terms of order of preference, for a "constant volume" reference or starting point can therefore be 30 summarised as:

1. The high or low of the relevant price cycle for each individual share;
- 35 2. The high or low of the relevant market cycle, applied to that market's index constituents en bloc;
3. The first of January;

4. Any other significant date.

Implementation

5

From the point of view of constructing a database, the idea of anchoring all the stocks at the same point in time has its obvious attractions, and from the practical aspect of system implementation it is the one which is to be recommended.

10 However, this still leaves the question of how to deal with "constant volume" charts constructed from time and sales data which is constantly entering and leaving the system, and which therefore represents somewhat of a moving target.

15 This needs to be addressed, because many users will expect the system to draw them a "constant volume" chart without them having to go into the trade-by-trade data and select the reference point. The system cannot be allowed merely to go to the first available trade in Time and Sales and start from

20 that point, because although it would produce the same chart during that day, the next day the starting point would be different, and so would the chart. In the Example above, it is possible to imagine how, if a real-life trader had acted on a valid signal at 3.00 p.m. on Day 3, it would be perplexing 25 if that signal apparently "vanished" on the next day, purely because the system was creating the chart using a different reference point (i.e. the beginning of the time and sales data, which had changed overnight).

30 In accordance with a preferred aspect of the invention, means are provided for tagging a trade, each time a "volume unit" completes. The tag preferably indicates how many of its shares were used to complete the last unit, and how many were carried forward to the next unit. Therefore, every time the 35 system receives a request for the chart to be drawn, it will go to the tag and calculate the chart *backwards* through the available data using the pre-set volume benchmark.

This provides a precise solution in the case of quasi-static "constant volume", but not for dynamic "constant volume". The latter requires the units to be based on the volume average benchmark prevailing at the time that each unit completes, not

5 the benchmark of a subsequent period. Working backwards from a tagged unit with the current volume average will not produce the same chart as working forwards through the data.

Producing dynamic "constant volume" charts for Time and Sales statistics therefore requires the system to calculate and

10 apply the dynamic volume benchmark progressively through the stored data, which may well not be considered worth the programming effort.

The foregoing discussion shows that systems which rely on time

15 and sales data, rather than a database, require more sophisticated programming than those which rely on a database.

Dynamic "constant volume" charts are not likely to be necessary, unless a state-of-the-art system is required. In

20 this event, both quasi-static and dynamic versions of the following can be provided.

Examples of preferred types of charts are the following :-

25 1. Charts based on the average daily volume traded during the previous calendar year.

2. Charts based on the four-hourly average of volume over the previous six months.

30 3. Charts based on the hourly average of volume over the previous three months.

35 4. Charts based on a user-selected average over their a selected previous time period, and a selected reference point.

Although the volume average in 1. to 3. drops to one-half and one-quarter of the previous one, the time period over which it

is based drops at the rate of half the previous period. This is in recognition of the fact that, in any period at all, a surprise announcement can lead to volume abnormalities, which could seriously distort shorter-term volume averages.

5

Trades Reported Late

Whether "late" is considered in official or practical terms, one hurdle with which the method of the invention has to deal 10 is the human element involved in the timely reporting of trades. In practice, the order in which trades are reported is unlikely to ever achieve perfect time order of execution. If an individual trade which is reported "late" does not affect the quoted price spread, then this is unlikely to 15 matter. However, in calculating where a "volume unit" ends, the borders of two units may become "blurred" as a result of late reported trades. This is not likely, except in exceptional circumstances, to affect materially the time and price at which a signal is given.

20

However, to avoid the situation where a material trade is reported materially late, a method of relaying this to the user may be provided. For example, where a "volume unit" 25 contains a late trade which is more than, say, 10% of the volume benchmark, and/or was traded at a price which was outside the range of the other trades in the unit, the unit is preferably "flagged". The user can then check the reason for the "flag", and avoid being misled when interpreting any "constant volume" signals which might result.

30

The method of the invention is based on the use of an historic volume benchmark to chop up data into units for display purposes. The use of a constant benchmark not only allows an immediate visual comparison between 3-D units, but it also 35 facilitates a mathematical comparison as well. Whilst this comparison can be achieved using fully dynamic charts, it requires less computer manipulation with the quasi-static version, and gives the latter some advantages.

Unit Shapes

A 3-D "volume unit" is made up of three elements.

5

- The pre-set level of volume (the benchmark)
- The range of price fluctuation whilst that level of volume is traded
- The time which elapses whilst that level of volume is traded.

10

The first is constant, but the second two are the variables in the chart. However, just as it is possible to derive the volume benchmark via an averaging process, so it is also 15 possible to arrive at price and time benchmarks in the same way. The time benchmark is obviously the calendar amount chosen by the user at the start of the volume-averaging process, i.e. a week, a day, an hour. The price benchmark is the average of the range of fluctuation during each of those 20 calendar periods. This is easily illustrated by reference to Figure 14.

This chart was constructed between May and August 1996, using the daily average volume for 1995, which was 3.32 million 25 shares. By deducting the daily low from the daily high for each trading day of 1995, it can be calculated that the average daily price range had been 10.68 pence. The three benchmark elements for use in 1996 were therefore:

30

- 3.32 million shares
- 10.68 pence
- one trading day.

Every "volume unit" in our Reuters chart can now be compared 35 to these price and time benchmark amounts. For ease of discussion we can view the benchmark "volume unit", not as a rectangle with dimensions of 3.32 million shares by 10.68 pence by one day, but as a cube 1 x 1 x 1.

Let us now review various shapes of "volume unit" in relation to this benchmark, although we only need to consider price and time because volume is the same in each box. In each case

5 below and in their respective illustrations, the vertical edge of each box is price and the horizontal edge is time. The left-hand unit represents the 1×1 benchmark unit. However, these could just as easily be successive "volume units", since it is not just the relationship between a "volume unit" and
10 its benchmark unit which provides signals, but also the relationship between two adjoining units. In fact, it is this latter relationship which is the more important of the two in real time.

15 The reason that this latter comparison is likely to be more important is that, in the short term, due to the herd-like nature of some market participants, volume begets volume, and vice versa. A constant level of volume over a shorter period of time represents greater activity. More activity draws
20 attention to itself, which is self-feeding, at least over that shorter horizon. The reverse is true for inactivity, on the basis that if there is nothing going on, then there is no reason to expect that condition to change.

Figure 15 illustrates the configuration of five different
25 levels of buying power:

(a) - Weak buying is occurring here. Although prices have risen and the close is higher, the price range has decreased, some trading occurred below the close of the first unit, and
30 the second unit took longer to produce the same level of volume.

(b) - This is moderate buying: a greater range, a close higher than the range of the first box, and the time taken matched
35 the first unit.

(c) - This is stronger still. It had an even higher close, and the time taken was less than the first unit.

(d) - Strong buying. The main features are that the time taken to accumulate the unit was half that of the previous unit, and no trading occurred beneath the previous close.

5

(e) - Aggressive buying. A big range; the close at the high; no trading beneath the close of the previous unit; the time taken was 30% of the previous unit. The market is being squeezed higher. Early in a price move this would be a very

10 bullish unit.

Figure 16 illustrates the relative configurations to be expected when there is indecision in the market:

15 (a) - Very indecisive. The second unit has twice the price range of the first, breaking above and below its range. The main feature, however, is the greater time taken to produce the same level of volume.

20 (b) - Time is equivalent between these units, but the range is still bigger in price terms. Buyers are willing to pay up for stock, and sellers are quite aggressive in the prices they will accept down to, but they do not appear to have large amounts to sell.

25

(c), (d) and (e) - Varying degrees of indecision, all marked by higher than average volume. Despite the apparent break in one direction or another during the period of completion of the unit, the price still closes near the closing price of the

30 previous unit.

35 Figure 17 moves closer to what are potentially the most profitable configurations - break-out warning patterns. The Japanese call these Harami (pregnant) due to being inside the boundaries of the previous unit:

(a) - Sellers and buyers are clearly operating at well defined limits, but do not appear to be overly worried about the speed of execution of their deals.

5 (b) - The pace steps up to average, and there are increasingly strong views held between the buyers and sellers.

(c) - Volume has increased significantly with the probability of an upside "squeeze" (see Figure 15(e)), and the beginning 10 of an uptrend.

(d) - The converse (see Figure 18 (e)).

Figure 18 illustrates the sell side of the Figure 15 15 configurations:

(a) - Weak selling.

(b) - Moderate selling.

(c), (d) and (e) - Progressively stronger selling, marked by a contracting time range, and a closing price at lower and lower 20 levels to reflect the higher volume levels.

In Figures 16 to 18 although it would have been correct, none of the units have been coloured in grey. This is to emphasise the time range of the second unit in relation to the first, 25 the position of the two closing prices and the range of the second unit in relation to the close of the first unit. All of these elements provide clues as to the balance of the buying and selling forces within the market. The other reason is that there is described below a new approach to quantifying 30 these forces in markets where time and Sales data is available. This is likely to prove more effective than merely looking at the direction of the subsequent close, when deciding what colour a unit should be.

35 Time Ranges and Variation Indicators

From a mathematical standpoint, the time taken for a unit to complete is generally more informative than its price range,

because it is directly related to the amount of activity in the market. I say "activity" because we take for granted the time element of quoted volume figures. If volume in Shell plc is quoted as 15,000,000, we automatically assume that this is 5 a daily figure. However, whilst volume is the statistical measure of business levels, it is activity which indicates the significance of events, being a combination of both volume levels and the time taken for the volume to be transacted.

10 In its 3-D form the method of the invention provides an immediate visual indication of activity because we can see the width of the units expanding and contracting as activity dwindle and rises. The statistical significance of this ebb and flow is easily measured by comparing the time taken for a 15 unit to complete against the time taken by the benchmark unit. If the latter is one trading day from 8.30 a.m. to 4.30 p.m., then the time taken from the close of the previous "volume unit" to the close of the current unit can be expressed as a percentage of that 480-minute benchmark unit. For example, a 20 unit which took from 8.47 a.m. to 11.59 a.m. lasted 192 minutes, or 40% of the benchmark. A user not employing the system of the invention would be able to see that volume was quite high that day, but he would not have the perspective of the user employing the system of the invention, who would know 25 that volume levels were 2½ times the benchmark. This calculation is therefore defined as:

$$TR\% = (T_0 \div T_b) \times 100$$

30 Where TR stands for Time Range, T_0 is the time taken by the current unit, and T_b is the time taken by the benchmark unit.

Whilst the benchmark comparison provides a potentially valuable insight, trading conditions may change sufficiently 35 that this is not enough to provide a totally adequate comparison in all circumstances. The relationship between adjoining units must therefore also be considered, since this

also provides a useful perspective on events, as the discussion on Unit Shapes revealed.

This second calculation is defined as:

$$5 \quad TC\% = (T_0 \div T_{-1}) \times 100$$

where TC stands for Time Chain, T_0 is the time taken by the current unit, and T_{-1} is the time taken by the previous unit.

10 Both of these calculations can then be used to provide time indicators, by the application of moving averages. These are included in the broader description Time Variation Indicators. In the following description, these are applied as part of the "constant volume" Alert Grid, to warn traders of shifts in

15 activity in stocks of particular interest to them.

Price Ranges

The significant advantage of the method of the invention is

20 that in general, relevant information becomes available somewhat earlier than when using conventional methods. When a price range becomes significant in relation to the benchmark, some of the benefit has already been exhausted, and so a larger-than-average price range merely tends to confirm what

25 may already have been evident from the dealing screen.

Additionally, a wide price range that does not come with a significant time range is of less interest anyway (see discussion of Figure 16(a)). The price range is therefore used only as part of the composite range indicator discussed below.

30 However, for consistency and completeness:

$$PR\% = (P_0 \div P_8) \times 100$$

$$PC\% = (P_0 \div P_{-1}) \times 100$$

35 Where PR stand for Price Range, PC stands for Price Chain, P_0 and P_{-1} are the current and previous units' price ranges, and P_8 is the benchmark unit's price range.

Trend Strength Index

In constructing these indicators, the objective is to provide the real-time user not only an immediate visual indication of 5 the significance of current trading conditions, but also a precise mathematical reading, which can be compared either to a benchmark, or immediately preceding units.

The visual significance is achieved by effectively comparing 10 the surface area and relative positioning of adjoining units. By using the Range calculations of price and time for the surface area, and the direction of the closing price as an approximation for relative positioning, we can now derive a mathematical reading for each unit. (Where a quasi-static 15 benchmark is used, and the long-term trend is strong, there are arguments for using the Chain % figures instead, because of distortions arising from a stretched relationship between benchmark and current price ranges after significant price appreciation). I have called this reading the Trend Strength 20 (TS) reading and the TS Index (TSI) is a moving average of individual TS readings. The formula for TS is:

$$TS = PR \times (1/TR) \quad , \text{ and}$$

25 if $C_0 > C_{-1}$ then $TS = +TS$, and

if $C_0 < C_{-1}$ then $TS = -TS$.

As previously, C_0 is the closing price of the current unit, and 30 C_{-1} is the closing price of the previous unit. Note that in this calculation the ordinary PR and TR ratios, as opposed to percentages, are used, in order to avoid the TS number from becoming cumbersome. The inverse of TR is used to reflect the fact that a smaller TR signifies greater strength.

35

Table 1 shows the spreadsheet calculations for the 5-day TSI and Trend Chain Indices of the Reuters 3-D chart of Figure 14.

TABLE 1

TABLE 1										TABLE 2										
START DATE	OPEN	HIGH	LOW	CLOSE	MINs	UNIT RANGE	PRICE RANGE	TIME RANGE	PRICE-R	TIME	PRICE-CH	TIME	PRICE-CH	TIME	PRICE-CH	TIME	PRICE-CH	TIME	PRICE-CH	
960627	775.00	771.00	773.00	773.00	532	14.00	1.31	0.98	1.28	1.26	1.43	1.76	0.57	0.61	0.81	0.61	0.81	0.61	0.81	
960628	773.00	773.00	785.75	1444	20.00	1.87	0.55	1.02	1.02	1.05	1.26	0.80	0.80	0.84	0.84	0.84	0.84	0.84	0.84	
960707	785.75	789.00	788.00	789.00	1168	21.00	1.97	0.44	0.86	0.86	1.05	1.26	0.80	0.80	0.84	0.84	0.84	0.84	0.84	
980705	789.00	790.00	790.00	790.00	752	23.00	2.15	0.68	1.48	1.48	1.09	0.64	1.55	1.69	0.49	0.49	0.49	0.49	0.49	
970708	773.50	775.00	771.00	774.00	288	4.00	0.37	1.90	0.71	0.71	0.46	0.17	0.36	2.81	0.49	0.49	0.49	0.49	0.49	
970708	774.00	779.00	779.00	773.00	651	18.00	1.50	0.78	1.17	1.17	0.46	4.05	2.43	0.41	1.67	1.67	0.42	1.67	0.42	
960710	775.00	780.00	758.00	763.00	816	22.00	2.08	0.63	1.29	1.29	0.00	1.37	1.25	0.80	1.09	1.09	0.04	1.09	0.04	
960711	763.00	769.00	747.00	752.00	278	22.00	2.06	1.83	3.78	3.78	-0.93	1.00	0.34	2.94	2.94	2.94	2.94	2.94	2.94	
960712	752.00	769.00	742.00	747.00	334	27.00	2.53	1.53	3.86	3.86	-1.41	1.23	1.20	0.83	1.02	1.02	0.58	1.02	0.58	
960715	747.00	750.00	719.50	719.50	507	30.50	2.86	1.01	2.87	2.87	-2.13	1.13	1.52	0.66	0.74	0.74	0.82	0.74	0.82	
960716	719.50	727.50	710.00	719.00	269	17.50	1.84	1.90	3.11	3.11	-3.11	-2.98	0.57	0.53	1.08	1.08	1.37	1.08	1.37	
960716	719.00	733.00	713.00	717.00	309	20.00	1.87	1.65	3.09	3.09	-3.09	1.14	1.15	0.87	0.99	0.99	0.99	0.99	0.99	
960717	717.00	725.00	714.50	721.75	275	10.50	0.98	1.85	1.85	1.82	-1.28	2.22	0.52	0.89	1.12	1.12	0.58	1.12	0.58	
960717	721.75	729.00	716.00	727.00	279	13.00	1.22	1.83	2.23	2.23	-1.00	1.24	1.01	0.99	1.22	1.22	-0.20	1.22	-0.20	
960718	727.00	737.00	723.00	730.00	363	14.00	1.31	1.40	1.84	1.84	-0.08	1.07	1.30	0.77	0.82	0.82	0.11	0.82	0.11	
960719	730.00	740.00	729.00	730.00	477	11.00	1.03	1.07	1.10	1.10	0.78	0.79	1.31	0.76	0.60	0.60	0.45	0.60	0.45	
960719	730.00	740.00	720.00	727.75	746	20.00	1.87	0.68	1.28	1.28	-1.28	1.14	1.82	1.56	0.64	1.16	1.16	0.41	1.16	0.41
960723	727.75	730.00	705.00	705.00	490	25.00	2.34	1.04	2.44	2.44	-2.44	0.29	1.25	0.66	1.52	1.52	1.52	1.52	1.52	
960724	705.00	715.00	695.00	697.00	200	20.00	1.87	2.55	4.78	4.78	-4.78	-1.11	0.80	0.41	2.45	2.45	1.96	1.96	1.96	
960724	697.00	718.00	691.00	718.00	176	25.00	2.34	2.90	6.78	6.78	-6.78	-2.84	1.25	0.88	1.14	1.14	1.42	1.42	1.17	
960725	697.00	700.00	690.00	697.00	60	10.00	0.94	8.50	7.98	7.98	-7.98	-4.65	0.40	0.34	2.93	2.93	1.17	1.17	1.52	
960725	697.00	697.00	680.00	682.00	209	17.00	1.59	2.44	3.88	3.88	-3.88	-5.17	1.69	3.48	0.29	0.49	0.49	0.49	0.49	
960725	682.00	692.00	687.00	687.00	152	10.00	0.94	3.35	3.14	3.14	-4.05	0.59	0.73	1.38	0.81	0.81	0.85	0.81	0.85	
960725	687.00	692.00	684.75	689.00	191	7.25	0.68	2.67	1.81	1.81	-2.73	0.72	1.26	0.80	0.57	0.57	0.57	0.57	0.57	
960726	690.00	701.00	683.49	695.00	352	17.51	1.84	1.45	2.38	2.38	-2.38	1.09	1.59	1.35	0.74	1.11	1.11	0.17	1.11	0.17
960729	695.00	703.00	688.00	688.00	229	15.00	1.40	2.23	3.13	3.13	-3.13	1.24	0.85	0.85	1.54	1.54	1.18	1.18	1.18	
960730	688.00	691.00	683.00	685.00	289	8.00	0.75	1.76	1.32	1.32	-1.32	0.54	1.26	0.79	0.43	0.43	0.43	0.43	0.43	
960730	685.00	687.00	679.00	679.00	145	8.00	0.75	3.52	2.83	2.83	-2.83	-0.54	1.00	0.50	1.99	1.99	-0.29	1.99	-0.29	
960730	679.00	691.00	670.00	672.00	209	21.00	1.97	2.44	4.80	4.80	-4.80	-1.90	2.63	1.44	1.82	1.82	-0.87	1.82	-0.87	
960731	672.00	673.00	684.00	686.00	232	9.00	0.84	2.20	1.85	1.85	-1.85	-2.75	0.43	1.11	0.90	0.39	0.39	0.39	0.39	
960731	666.00	666.00	673.50	689.00	89	10.00	0.94	5.73	5.37	5.37	-5.37	-1.05	1.12	0.38	2.61	2.61	2.92	2.92	2.92	
960801	673.50	679.00	670.00	675.00	132	9.00	0.84	3.86	3.28	3.28	-3.28	-0.13	0.90	1.48	0.67	0.67	0.61	0.61	0.61	
960801	675.00	680.00	673.00	677.50	163	7.00	0.66	3.13	2.05	2.05	-2.05	0.81	0.79	1.24	0.81	0.81	0.64	0.64		
960801	677.50	682.00	675.00	680.75	133	7.00	0.66	3.83	2.51	2.51	-2.51	2.27	1.00	0.82	1.23	1.23	1.00	1.00		
960801	680.75	693.00	674.00	689.00	102	19.00	1.78	5.00	8.90	8.90	-4.42	2.70	0.77	1.30	3.52	3.52	1.78	1.78		
960802	689.00	695.00	682.00	693.00	183	14.00	1.31	2.79	3.65	3.65	-4.07	0.74	1.79	0.56	0.41	0.41	0.41	0.41		
960802	693.00	701.00	681.50	694.00	482	19.50	1.83	1.06	1.93	1.93	-1.40	1.83	2.63	0.38	0.53	0.53	0.53	0.53		
960803	694.00	705.00	691.00	702.00	616	14.00	1.31	0.83	1.09	1.09	-3.62	0.72	1.28	0.78	0.56	0.56	0.56	0.56		

START DATE	OPEN	HIGH	LOW	CLOSE	MINS	UNIT RANGE	TIME RANGE	PRICE-R	TIME x TIME-R	TREND	6-day TSI	PRICE-CHAIN	TIME HAIN IN	TIME x TIME-CH	PRICE-CH	CHAIN STRENGTH	5-day
																	CHSI
960806	702.00	709.00	700.00	705.00	121	9.00	0.84	4.21	3.55	3.55	3.82	0.64	0.20	5.09	3.27	3.27	1.66
960806	705.00	725.00	705.00	726.00	125	20.00	1.67	4.08	7.64	7.64	3.57	2.23	1.03	0.97	2.16	2.16	1.39
960807	725.00	734.00	723.00	730.00	113	11.00	1.03	4.61	4.63	4.65	3.77	0.65	0.90	1.11	0.61	0.61	1.43
960807	730.00	734.00	727.00	728.00	161	7.00	0.66	3.17	2.08	2.08	2.97	0.64	1.42	0.70	0.45	0.45	1.23
960807	728.00	738.00	724.00	738.00	635	14.00	1.31	0.80	1.05	1.05	2.96	1.98	3.94	0.25	0.50	0.50	1.22
960809	738.00	745.00	724.00	734.00	487	21.00	1.97	1.09	2.16	2.15	1.62	1.50	0.74	1.36	2.04	2.04	0.16
960812	734.00	750.00	732.50	748.00	558	17.50	1.64	0.91	1.50	1.50	0.59	0.83	1.19	0.84	0.70	0.70	0.14
960813	748.00	750.00	742.00	749.00	379	8.00	0.75	1.35	1.01	1.01	-0.13	0.46	0.68	1.47	0.67	0.67	0.12
960813	749.00	756.00	736.00	748.00	156	18.00	1.69	3.27	5.51	5.51	-0.82	2.25	0.41	2.43	5.47	5.47	5.47
960814	748.00	754.00	742.00	748.00	735	12.00	1.12	0.69	0.78	0.78	-1.18	0.88	4.71	0.21	0.14	0.14	1.13
960815	748.00	767.00	745.00	765.00	529	22.00	2.06	0.86	1.99	1.99	-0.36	1.84	0.72	1.39	2.58	0.56	0.56
960816	765.00	767.50	760.00	764.00	295	7.50	0.70	1.73	1.21	1.21	-1.21	0.90	0.56	1.79	0.61	0.61	1.00
960817	764.00	770.00	752.00	758.00	1201	18.00	1.69	0.42	0.72	0.72	-0.72	1.25	0.41	4.07	0.25	0.59	1.25
960821	758.00	772.00	748.00	787.00	727	28.00	2.43	0.70	1.71	1.71	0.20	1.44	0.60	1.67	2.41	2.41	0.33
960823	767.00	775.00	755.00	771.50	1651	20.00	1.87	0.31	0.58	0.58	0.47	0.77	2.27	0.44	0.34	0.34	0.42
960829	771.50	772.00	750.00	751.00	721	22.00	2.06	0.71	1.48	1.48	-0.22	1.10	0.44	2.29	2.52	2.52	0.19
960830	751.00	758.50	740.00	748.00	1058	18.50	1.73	0.48	0.83	0.83	-0.14	0.84	1.47	0.88	0.57	0.57	0.19
960893	748.00	764.00	745.00	761.00	1778	19.00	1.78	0.29	0.51	0.51	0.10	1.03	1.68	0.60	0.61	0.61	0.05
960909	761.00	764.00	746.00	761.75	664	18.00	1.69	0.77	1.29	1.29	-0.50	0.95	0.37	2.68	2.54	2.54	0.94
960910	751.75	780.00	743.00	780.00	387	37.00	3.46	1.32	4.57	4.57	-0.30	2.05	0.58	1.72	3.52	3.52	0.30
960911	780.00	787.00	761.00	772.00	11	26.00	2.43	46.36	112.87	112.87	-10.00	-1.41	0.70	0.03	35.18	24.72	24.72
960911	772.00	779.00	765.00	769.00	22	14.00	1.31	23.18	30.39	30.39	-10.00	-3.24	0.54	2.00	0.50	0.27	0.27
960911	769.00	772.00	757.00	768.00	147	15.00	1.40	3.47	4.87	4.87	-4.32	1.07	6.68	0.15	0.16	0.16	4.83
960911	766.00	769.00	769.00	760.00	228	9.00	0.84	2.24	1.88	1.88	-3.68	0.60	1.55	0.64	0.39	0.39	4.25
960912	769.00	770.00	755.00	760.50	407	15.00	1.40	1.25	1.76	1.76	-1.76	4.95	1.67	1.79	0.56	0.93	0.93
960913	760.50	767.00	757.00	763.00	575	10.00	0.94	0.89	0.83	0.83	-2.78	0.67	1.41	0.71	0.47	0.47	0.10
960916	763.00	769.00	757.00	765.00	815	12.00	1.12	0.83	0.70	0.70	-0.64	1.19	1.42	0.71	0.84	0.84	0.03
960917	765.00	765.00	757.00	757.00	587	8.00	0.75	0.87	0.65	0.65	-0.20	0.67	0.72	1.39	0.93	0.93	0.12
960918	757.00	764.34	750.00	762.00	630	14.34	1.34	0.81	1.09	1.09	0.04	1.79	1.07	0.93	1.67	1.67	0.14
960920	762.00	762.00	752.50	753.00	602	8.50	0.89	0.85	0.75	0.75	-0.76	0.24	0.88	0.98	0.69	0.69	0.18

Figure 19 illustrates those statistics, using a conventional bar format to show "standard constant volume" plots, and the 5 TS Index as vertical bars beneath. Negative TSI readings are highlighted with a dot at the high point of their bar. The main features of this are:

1. The uptrend in negative TS readings into mid-July, 10 confirming the bearish trend.
2. The lower negative TS readings into end-July, just as the trend was about to turn.
- 15 3. The best positive TS reading to that point as the new uptrend begins.
4. The uptrend is confirmed after 5 units, with a positive TS reading which betters the degree of the most negative 20 reading during the downtrend.
5. The action in early September as Reuters announced its share buy-back is also worthy of comment. The positive reading at point 5 in Figure 19 is the best for 18 units. 25 However, it does not better the readings of +5 as seen in the early- or mid-trend period. The big price range is the dominant factor in this reading of +4.57, which should put the user on guard that this is more of a price mark-up than genuine buying. The two subsequent negative readings greater 30 than -10 warned that more concerted selling had come into the market, and a 40p decline followed.

For scaling reasons as much as anything else, TS readings of greater than 10 are only shown as 10. This implies strength 35 or weakness of 10 times the benchmark unit. Whether it is 10 or 40 times as great, the message does not materially increase in intensity beyond double digits, and beyond about 10 there is always the chance that the reading is caused by a surprise

announcement, which has materially changed the supply/demand balance.

Figure 20 illustrates the 5-day TSI and 5-day Trend Chain Index (TCI). Note the bullish divergence signals at the end of July as the TSI and TCI do not produce new lows when the price does. This is warning the analyst of the potential for a reversal of the downtrend.

10 **"Constant volume" Balance Indicators and the "constant volume" Alert Grid**

The rules outlined above for determining whether a "volume unit" should be coloured "white" or "grey" by comparing its position and/or closing price in relation to the previous unit employ fairly standard technical analysis logic. For instance, if the closing price of the latest unit is lower than the closing price of the previous unit, then the volume in the latest unit is assumed to be predominantly selling volume, hence the "grey" colouring. Whilst this may be a reasonable assumption generally in relation to units with lower closes, in respect of any one unit it may be giving a false impression of what is likely to happen next. In accordance with a further preferred embodiment of the invention, a "balance indicator" is derived. In any transaction there is always a buyer and a seller. However, the parties to the transaction often perform different functions in the market. One is taking a view as a trader or investor, whereas the other is providing liquidity to the market as a market-maker or an equivalent. If traders are buying and the market-makers are selling, there are considered to be "buyers in the market", whereas if it is the market-makers who are doing the buying from the traders or investors, then there are said to be "sellers in the market". By analysing the trade-by-trade statistics of a "volume unit", it is possible to arrive at a more accurate picture of the forces at work, and therefore their probable impact on the trend of prices - and often earlier than using existing chart techniques.

"constant volume" Balance

The Balance indicator is derived as follows. If the trade
 5 price lies above the mid-price of a quoted bid/offer spread,
 then the trade is assumed to be a purchase, whereas if it lies
 beneath the mid-price it is assumed to be a sale. Those rarer
 trades executed as the mid-price are assumed to be a purchase
 and a sale on a 50:50 basis (which on a longer-term view will
 10 be approximately correct, if not for every trade).

Table 2 illustrates this process for an hour's worth of
 trading in Glaxo Wellcome plc, showing the accumulation of Buy
 and Sell volume based on this process. During this period the
 15 ratio split almost exactly 60% buyers : 40% sellers, so the
 buyers clearly predominated, which was reflected by the rise
 in the quote from 946/949 to 947/950 over the hour.

The buyer/seller ratio can be conveyed to the user in a
 20 number of ways, for example:-:

1. A coloured "standard constant volume" chart showing the
 exact percentage split, with the Buy percentage being shown in
 green and the Sell percentage in red. (As illustrated
 25 schematically in Figure 21).

2. An indicator which shows the Buy percentage only,
 fluctuating between 0 and 100%.

330 3. A summary format as described below. (This requires
 research as to the actual cut-off percentages to be used.
 Levels of 45/55% are assumed for the purposes of initial
 illustration as illustrated in Figure 22).

35 The summary format may preferably be used with 3-D charts in
 place of the white/black colouring, to provide the "more
 scientific" indication of buying or selling volume.

The units would be coloured as follows (as illustrated in Figure 22):

- Green: If the Buy % is 55% or greater
- 5 Orange: If the Buy % is between 45% and 55%
- Red: If the Buy % is 45% or less

Figure 23 is an Example of the summary format, applied to the data of Figure 14.

10

In conventional Bar chart, the daily range of the High/Low bar could be represented by a daily box instead, which is itself coloured in the same way as described in 1. or 3. above. For future reference, this technique will be referred to as a

15 Daily Balance chart.

The method can also be applied to indices, but the manipulation is more complex because the impact on the market of the volume of an individual stock will depend on both the

20 level of its share price and the company's capitalisation.

Balance Shift Indicator

In accordance with a preferred aspect of the invention, means are provided for calculating, whilst a "volume unit" forms, a value indicative of the percentage of shares traded on the "buy" side or on the "sell" side of the market, depending upon whether the price at which the said shares are traded is higher or lower than a predetermined value, and for displaying

30 a the said value graphically.

The indicator can be used as a substitute for the Green and Red coloured chart illustrated in Figure 21.

35 One aspect of this method of conveying the detailed statistics of the Balance of each "volume unit", is its potential as a medium-term trend termination indicator. By applying a moving average to the Buy percentages to remove unwanted "noise" and

the odd "rogue" unit, the analyst may be able to identify when a trend is in danger of reversing. As an uptrend rolls over into a downtrend, and vice versa, the demand/supply balance will alter. However, when a consolidation within the trend 5 occurs there may well not be an obvious shift.

The length of the moving average will depend on the trading or investment horizon of the user. When the moving average crosses up through the 50% line from below, this will indicate 10 that buyers have gained the upper hand over sellers, and vice versa for a cross downwards through 50%.

Recognising consolidations and corrections within the trend, as opposed to the early stages of a change of trend, is often 15 difficult for the analyst. To the extent that a consolidation in an uptrend may merely be a reflection of market-maker mark-downs and light selling from short-term traders, an averaged Balance indicator may provide a useful distinction from the more concerted selling which is needed to produce a more 20 prolonged downturn in prices.

For order-driven market systems, as introduced to the UK in 1996, the Balance concept remains valid. Looked at in its most basic form, Balance is intended to be a trend predictor, 25 and it is easy to see why it should function effectively in a market-maker type system. Market makers provide a pool of liquidity/shares, so if an investor sells into the pool, it grows, and if it grows too big the market-maker will lower his price with the expectation that buyers will come in and return 30 his book towards equilibrium levels. By examining the trade price in relation to the bid/offer spread, the Balance technique is therefore able to imply when there are enough sellers to produce lower prices and when there are enough buyers to produce higher prices.

35

Whilst the argument is not the same in an order-driven system, the outcome should be, since the willingness to trade at one side of the order book or the other has trend implications,

reflecting a move away from the equilibrium. In equilibrium, there will be no trades, since the buyers (the bid side) will not pay that extra amount required by the sellers (the offer side) for a transaction to take place. However, when a buyer 5 pays up, the equilibrium is potentially disturbed, and unless a seller comes in to restore equilibrium a trend will develop. Therefore, during the accumulation of a volume unit, by measuring whether there are a greater number of equilibrium disturbances (i.e. trades) on the bid or offer side, the 10 Balance indicator can be used to forecast whether an uptrend or downtrend in prices is more likely during the next accumulated unit.

The Urgency Oscillators

15

The Balance technique aims to indicate whether there is a predominance of buyers or sellers during the accumulation of a volume unit. This indicator is intended to show how keen those buyers or sellers are, by comparing the price they pay 20 in relation to the quoted bid/offer spread, and weighting the volume they generate in direct proportion. The accumulated weighted volume is then compared to the benchmark volume, and plotted as two oscillators either side of the 100% level (i.e., the benchmark). As trends begin to develop, the Buy- 25 side Urgency Oscillator will produce more positive readings ahead of or coincident with uptrends, and more negative readings will appear in the Sell-side Oscillator as sellers exit in or ahead of downtrends. Extreme readings are also likely during buying or selling climaxes.

30

Calculating the Urgency Oscillators for each volume unit involves the following variables:

P_t = Trade Price
35 P_s = Order Book sell price
 P_b = Order Book buy price
 P_m = Order Book mid price
 V_b = Benchmark volume

V_T = Trade volume
 V_B = Adjusted trade volume on the buy side
 V_S = Adjusted trade volume on the sell side
 B_B = Volume of Buy trades in Balance indicator
 5 B_S = Volume of Sell trades in Balance indicator

The calculation is as follows:

If P_T > P_B, then V_B = V_T × P_T/P_B
 If P_S < P_T <= P_B, then V_B = V_T
 If P_B <= P_T < P_S, then V_S = V_T
 10 If P_T = P_S, then V_B = ½V_T and V_S = ½V_T
 If P_T < P_S, then V_S = V_T × P_T/P_S

The Buy-side Oscillator : U_B = $(\sum V_B) / B_B$

The Sell-side Oscillator : U_S = $(\sum V_S) / B_S$

15 **Alert Grid**

The above discussion deals with the signals that can be
 gleaned from the price and time ranges of a "volume unit",
 when compared to the price and time range of the benchmark
 20 which is used to chop up trade-by-trade data into the
 "constant volume" configuration. In accordance with a further
 preferred embodiment of the invention, an "Alert Grid" is
 derived, which marries elements of both the Balance and Range
 indicators to provide a dealing aid to help both traders and
 25 investors with the execution of their trades, or to facilitate
 the monitoring of developments in a pre-selected list of
 shares.

The list of shares is input into the Grid, after ensuring that
 30 the volume benchmark chosen is appropriate to the user's time
 horizon. For example, someone who is day-trading will not
 want to use an historic benchmark equivalent to a day's worth
 of trading volume - it would be too insensitive to be certain
 to provide usable signals. Conversely, a dealer at an
 35 institution wanting to implement a sizeable investment
 programme will not want to use a benchmark based on historic
 half-hourly volume levels, particularly if they are trying not
 to disturb market prices too much with their large orders.

The Alert Grid is split into three columns to represent the three summary format colours of the Balance calculation:

Green, Amber and Red. This tells the user whether the deals

5 during the latest "volume unit" were predominantly on the Buy or the Sell side, for each stock respectively. The three broad horizontal bands are used to section off stocks according to the capitalisation bands of the main indices (i.e. FTSE 100, FTSE 250, and other All-Share constituents).

10

The percentage figure alongside each stock represents the time taken to complete the latest "volume unit", as a percentage of the time taken to complete its benchmark volume unit (This is the TR% described above). The smaller the percentage figure,

15 the greater the activity in the stock, and, therefore, potentially the greater the interest to the Grid user.

Preferably, the "alert grid" carries two figures alongside each stock, the TR%, and the TC figure as described above. It 20 is preferable that the TC% is not used, since by showing the simple ratio, the user will be less likely to be confused as to which figure is which.

Each horizontal index band orders the stocks so that the most 25 active appears at the top of the list. This allows the user to immediately tell: which stocks most require their attention; the likely trend of the stock (green implies up; red implies down); how active it is by historical comparison.

The user can then assess the "risk" to his current position 30 with respect to any individual stock. It might be that they wish to buy a Green stock with a low percentage against it.

In this instance, if they do not deal quickly, they may end up buying at higher prices later, because there are already buyers very active in the stock. Conversely, a Red stock with

35 a low percentage is likely to decline due to active sellers, so the trader may wish to delay acting on any buy instructions in anticipation of lower prices, or act immediately if the deal is on the sell side.

The example Grid illustrated in Figure 24 assumes that the user is a specialist in the Media sector. The risks are fairly immediately clear: Being short of Carlton, WPP,
5 Cordiant, and perhaps United News; being long of Reuters, EMAP and M.A.I.D. A careful watch is needed on Daily Mail and Mirror where the balance could quickly tip one way or the other

10 The user will always need to check the underlying statistics especially when using anything involving the Balance summary format, and even these implied results should not then be used in isolation. The Grid gives an accurate summary of what has just happened, and the immediate past is not always a good
15 guide to the immediate future.

Computer Graphics Packages

The system according to the invention employs an appropriately
20 programmed computer to derive the volume benchmark, and to implement the other calculations and manipulations necessary. The particular way in which this is implemented in computer software is well within the capabilities of one of average skill in the art, from the general description herein. In
25 general, this will involve a database to configure real-time data into volume units, and store details of the said units. The computer system preferably also provides for more conventional analysis methods, in addition to methods employing the system of the invention. Figure 25 is a
30 schematic representation of a suitable user interface.

The system may also provide means for storing one or more of the derived parameters referred to above, and/or for deriving and storing "constant volume" information from historical data
35 in order to provide a basis for historical comparison.

Claims

1. A system for the dynamic tracking of price movement of a traded commodity, comprising a database for storing details of transactions in the commodity,
 - 5 means for calculating from the data in the database a volume benchmark, indicative of the average volume of the commodity which has been traded during a preceding time period,
 - 10 means for summing transaction volumes in the commodity dynamically to produce a running accumulated transaction total,
 - 15 means for comparing the running accumulated transaction total with the said volume benchmark, and for thereby determining the time period during which a volume of transactions corresponding to the said volume benchmark occurs, and
 - means for providing a graphical visual indication of the said time period, thereby to provide a representation of the level of transactions in the said commodity.
- 20 2. A system as claimed in Claim 1 wherein the volume benchmark for a plurality of successive time periods is the volume of trade in the commodity which takes place in a fixed first period, averaged over a fixed second period.
- 25 3. A system as in claimed Claim 2, wherein
 - a) the said fixed first period is a day and the said fixed second period is a calendar year, a 20-day period, or a calendar month, or wherein,
 - b) the said fixed first period is a week and the said fixed second period is a calendar year, a 4-week period, or a calendar month, or wherein
 - 30 c) the said fixed first period is a calendar month, or a 4-week period and the said fixed second period is a calendar year.
- 35 4. A system as claimed in Claim 1 wherein the volume benchmark is a moving average of the volume of trade in

the commodity which takes place during a preceding period.

5. A system as claimed Claim 4, wherein the volume benchmark is a moving daily average of the volume of trade in the commodity which takes place over the preceding 20 day period.

6. As claimed in Claim 1, wherein the volume benchmark indicative of the average volume of the commodity which has been traded during a plurality of preceding time 10 periods, is the average number of units of the commodity which have been traded during a preceding period, or is the average value of the units of the commodity which have been traded during a preceding period.

7. A system as claimed in any one of the preceding claims, 15 wherein the graphical representation includes the maximum and minimum price of the said commodity within the said time period.

8. A system as claimed in any one of the preceding claims, 20 wherein the graphical representation includes the price of the said commodity at the start and at the end of the said time period.

9. A system as claimed in any one of the preceding claims, 25 wherein the graphical representation includes a rectangle representing each said time period, the height of the rectangle being proportional to the difference between the maximum and minimum prices of the said commodity over the period, and the width of the rectangle being proportional to the length of the said period.

10. A system as claimed in any one of the preceding claims, 30 including means for recording, for each commodity transaction

- the time of the first trade
- the price of the first trade
- the highest price traded
- the lowest price traded, and
- the price of the last trade.

11. A system as claimed in any one of the preceding claims, including means for colour coding the said representation.
12. A system as claimed in any one of the preceding claims, including means for calculating for each said volume unit, a value indicative of the percentage of shares traded on the "buy" side or on the "sell" side of the market, depending upon whether the price at which the said shares are traded is higher or lower than a predetermined value, and for displaying the said value graphically.
13. A system as claimed in claim 12, including means for providing colour coding depending on the said value indicative of the percentage of shares traded on the "buy" side or on the "sell" side of the market.
14. A system as claimed in any one of the preceding claims, including means for tagging a trade as one completing a volume unit, and for indicating how many of the shares of the tagged unit were used to complete the last unit, and how many were carried forward to the next unit.
15. A system as claimed in any one of the preceding claims, including means for selecting a start date for the volume benchmark corresponding to the high or low of a price cycle.
- 25 16. A system for the dynamic tracking of price movement of a traded commodity substantially as hereinbefore described with reference to and as illustrated by the accompanying drawings.



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Claims searched: 1-16

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Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.R): G4A (AUXF)
Int Cl (Ed.7): G06F
Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	US 5347452 (BAY JR) eg abstract	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.